METAL INDUSTRY

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Extraction Metallurgy

WITH a successful history going back longer than any written records, extraction metallurgy began as an art and many phases of it remain an art even today. But in no other field of metallurgy have there been, in the past few years, so many rapid changes in the application of both science and new engineering techniques. To meet the demands of the nuclear age, however, metals will have to be improved in all possible ways. More consistent properties will have to be guaranteed which means that refining will have to be more carefully controlled or carried to higher degrees of purity than hitherto. New methods will have to be devised to produce metals such as the rare earths on a commercial scale so that the next thirty years are likely to see far greater changes than have been seen since 1930, since when, it will be recalled ion exchange, solvent extraction, bomb reductions, pressure leaching, zone melting, vacuum and high pressure methods of extracting metals have been developed.

Fortunately, as Dr. F. D. Richardson remarked in his inaugural lecture as Professor of Extraction Metallurgy at the Imperial College of Science and Technology "the scientific background to extraction metallurgy is developing fast and the pace will assuredly increase as the years go by. The chemistry and physics of metallurgical systems will become far more highly developed in the region 1,000°C. to 2,000°C. and big efforts will undoubtedly be made to prosecute research in the region 2,000°C. to 3,000°C. These changes will inevitably be attended by a decline in empiricism in the operation and development of extractive processes." Evidence of the development of the scientific background is provided by the fact that since 1940 important research centres have been established in Britain, France, Germany and Russia as well as those in the U.S.A. One of the striking developments of the past twelve years and one in which the Chemistry and Metallurgy Departments of Imperial College have made the major contributions, is the theory of silicate melts. In the same period knowledge of the thermodynamic properties of metal solutions has greatly increased; knowledge of great value from the standpoints of the deoxidation and desulphurization of metals and of refining in general.

Since the emphasis in the field of extraction metallurgy is on change, it is inevitable that there must be changes in the methods of teaching at university level in this subject. As Dr. Richardson pointed out it is essential that the student should be given as adequate a fundamental background as possible for *twenty* years ahead and that special attention should be given to those matters that the student will find most difficult to learn, once he has entered industry. More time must be devoted to the pure sciences of chemistry, physics and mathematics and the applied sciences of heat and mass transfer; these last two topics especially, the very basis of process engineering, are rarely taught with sufficient thoroughness in metallurgy courses. Although this will mean that the student will inevitably have a less detailed knowledge of current processes than possessed by his predecessors and therefore may be at a slight disadvantage when first entering industry, he should be much better equipped to face the production and development problems that come his way.

Out of the MELTING POT

Gently Does It

ANYBODY in the fortunate position of considering the choice of a metallurgical subject for fundamental research work, could hardly do better than choose to investigate the possibilities of producing perfect single crystals. Such a choice would have a number of advantages. He would have a few modest successful examples to spur him, and he would have the advantage of being able to make his research as basic as he cared and yet always remain within easy reach of practice. Above all, the usual initial survey of the field cannot fail to leave him with more than enough ideas, impressions, "hunches," and the like. Probably the most useful approach to them all, which at the same time would also provide an indication of the path to be followed in the further research itself, would be the realization of the general trend towards what might be called gentler methods of production. Relevant signposts to this trend include the production of metals by reduction of aqueous solutions of metal salts with hydrogen or other reducing gases. The recently developed but little known hydrothermal methods for the production of synthetic crystals of, for example, quartz and alumina, point in the same direction. Thus, whereas formerly the production of synthethic sapphire crystals was invariably considered to require the extreme conditions of fusion, relatively large strain-free sapphire crystals are to-day being grown by dissolving and crystallizing aluminium oxide from an aqueous solution under high pressures and at temperatures which, although high, are far below those of the oxy-hydrogen flame in the Verneuil process. In the field of metal crystals itself, this trend has led from the "primitive" fusion methods to vapour reduction methods of growing crystals, and to a method of producing rod-like high strength single crystals of iron by reducing precipitated ferric hydroxide with hydrogen in the presence of ammonium chloride at 600°-800°C. The same trend may yet lead to the growing of such crystals by methods involving, by analogy with the hydrothermal methods mentioned above, the solution and crystallization of metals in fused salts under appropriate conditions of temperature and pressure. The trend seems definitely worth following.

Symptoms ?

IN the absence of anything corresponding to a presidential address at a conference—in a recent one of which doubts were expressed as to the value of proliferating conferences—similar doubts regarding the ever-increasing numbers of educational lectures, part-time and full-time training courses, sandwich courses, refresher courses, and such like, remain as yet unexpressed. There are, of course, the economic factors which operate in the case of both conferences and training courses to strike a balance between the time spent at conferences or on training courses and the time spent in deriving the benefits, if any, from whatever has been acquired as a result of the conferring or the training. The effectiveness of the economic factors, however, is severely limited by the number of imponderables and assumptions they encounter in their attempts to perform their duty. Economic factors, however hard, can make little impression once it has been accepted, as it so often is, that it would be a good thing for somebody to attend a conference or to spend a fortnight on a training course. Limited economic considerations apart, there still remain untouched the wider aspects presented by the need, if need it is, for all this training. A study of them would have to be preceded by some sorting out of the subject matters. Of these, specialized subjects would then present little difficulty. There would remain a large number of broad subject matter courses which, like the corresponding reading matter, while they are commonly regarded with some justification as an antidote to excessive specialization, also have a tendency to have assigned to them an intrinsic value which they do not possess. This suggests that the use of this particular antidote is rapidly becoming a bad habit, and as such a symptom of some deep-seated malaise.

Firing Method

TO differential thermal analysis, microscopic examination, X-ray diffraction, and all the other familiar and less familiar ways of investigating phase diagrams may now be added a method consisting in firing spherical pellets of the alloy at targets of the same composition as the pellets. Not, let me hasten to add, that such a method has been intentionally developed for the purpose of studying phase diagrams. The possibility of such a method does, however, emerge from the results of some recent experiments on crater formation in metallic targets. These experiments were intended to add to the still incomplete and incoherent understanding of the phenomena associated with high velocity impact. As an aside, it may be mentioned that our understanding of phenomena to be observed in the adjoining field of high speed deformation is likewise far from complete. Not that this lack of understanding is stopping the rapid empirical development of the art of metal forming under conditions of literally explosive pressure application, in which conditions metals can be made to behave in all sorts of ways in which they would not behave under stresses applied at normal metal working rates. In view of the practical advantages that can be derived from the former behaviour, the need for all possible information on what might be called the supersonic deformation of metals—a deformation which metals undergo before, as it were, they realize what is happening to them—will be self-evident. Changing the prefix from super- to ultra-, the search for such information could certainly be pursued with advantage into the field of ultrasonic deformation, or shall we say behaviour, of metals, of which (for the time being?) ultrasonic welding is the only example. To return to the experiments on crater formation, they included the firing of small spherical pellets of a number of metals and of a complete range of lead-tin alloys at speeds from 0·75 to 2·25 km/sec. into relatively large cast metal targets, and determining the dimensions of the craters produced. In the case of the lead-tin alloys, the crater volume per unit energy values were found to correlate closely with the lead-tin phase diagram. Abrupt changes in cratering characteristics occurred throughout the alpha and beta solid solution regions, whereas little change was observed throughout the central region where the eutectic microconstituent was present.

Skimmer

Northern Aluminium Co. Ltd. : Handsworth

By L. FLETCHER

With its headquarters at Banbury, Northern Aluminium Co. Ltd. also has plate and extrusion facilities in South Wales and founding and forging plant at Birmingham. The latter works were visited recently by delegates to the Golden Jubilee Autumn Meeting of the Institute of Metals, and a description of the equipment and processes they were shown is given here.

IN the Birmingham works of Northern Aluminium Company Limited there are three main production departments, namely, foundry, forge, and conductor accessories. In addition to these there are ancillary units, such as toolroom, pattern shop, etc., where all production equipment for use within the factory is made.

The site covers an area of approximately seven acres, and some 800 workpeople are employed.

The Foundry

The foundry may be considered as three production departments, each making one type of product: the sand foundry, main gravity die foundry, and piston (gravity die) foundry. The foundry was first built in 1926 for the production of sand and gravity castings, and the metal stores extension was added in 1942.

The piston foundry is completely self-contained, with its remelting, casting, fettling, and intermediate inspection departments all under one roof; the other foundries share another building, and have common remelting and fettling units. Other departments, such as material stores, heat-treatment and final inspection, are used by all three foundries.

Raw material is received in the form of pigs and notch bars, which are stored in a central position from which each of the foundry remelt departments may be easily and rapidly supplied. In this raw material stores, also, is kept the process scrap which is collected each day from the fettling shop and sorted ready for re-use. As the metal stores are immediately adjacent to the main remelt department, serving both the sand foundry and main gravity die foundry, metal for remelting can be delivered direct to the furnaces in stillages. Fork-lift trucks take metal from stores to the separate remelting furnaces in the piston foundry, little more than fifty yards away.

As the sand and main gravity die foundries are situated in adjacent bays, one remelt department, occupying a part of each foundry is able to serve both. Remelting is carried out in two reverberatory type tilting furnaces of 8,000 lb. capacity and seven crucible furnaces of 550 lb. capacity, all oil-fired.

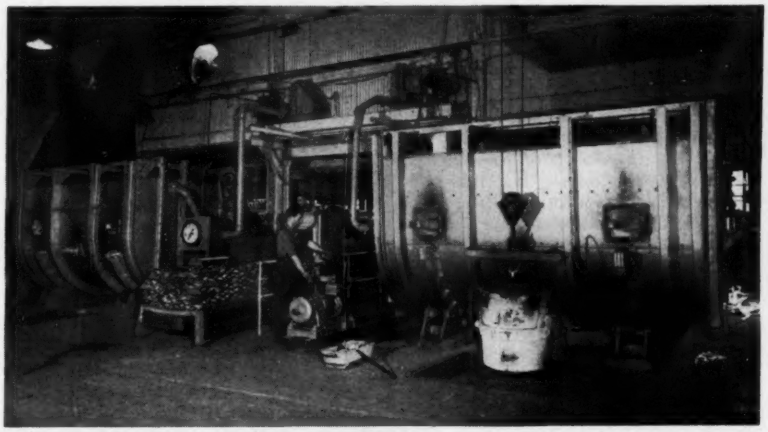
Melting in the larger furnaces, which are used only when large quantities of the same alloy are required, may take from about 4 hr. to 6 hr., while the charges in the smaller furnaces are ready for pouring after about 1½ hr. As with the metal temperatures, which range between 680° and 750°C., the melting times vary according to the weight of charge and the alloy.

The furnaces are tapped into ladles of 600 lb. capacity and here the metal is degassed, before it is poured into holding furnaces of the bale-out type, where it is kept at a steady temperature ready for use either in the sand moulds or the gravity dies.

In the core shop, cores are produced by three methods: conventional oil sand method, shell method, and CO_2 method.

Sand required for moulds and cores is prepared in the core shop, which is conveniently sited next to the sand foundry. Natural clay-bonded quarry sands, to which has been added a small proportion of sea sand, are generally found ideal for moulding, while the sand most often used for conventional cores is Congleton silica sand, mixed with maize flour, linseed oil and water to give the required combination of properties; to this mixture red quarry sand from Bromsgrove (which may be used also as a filling for large moulds) is sometimes added.

Special resins are mixed with sea



Two oil-fired tilting furnaces of 8,000 lb. capacity form part of the main remelt department

Cores being prepared in the core shop. Those on the conveyor in the foreground are ready for baking

The piston foundry showing pistons being cast, fettled and machine-tested and the roller conveyor that connects these operations

sand and cured by heat to form shell cores. To form CO_2 cores, silicate of soda is mixed with sea sand, carbon dioxide being injected into the core boxes after filling, with a resultant hardening of the mixture, which needs no further baking.

All core sands are completely dried in an oil-fired dryer before they are mixed, ready for core making, in rotary-type machines. For the rapid production of the smaller cores that are needed in large numbers, three core blowing machines are available, and a vibratory machine is installed to remove cores of complicated design from their boxes.

As the cores are prepared, they are placed on a roller conveyor that delivers them either to two vertical gas-fired stoves, in which they are baked to harden them off, or to assembly points adjacent to the conveyor. Very large cores, which are made on the floor at one end of the shop, are baked in a battery of 8 ft. by 8 ft. square static gas-fired stoves.

After baking, curing or gassing, all cores are inspected and checked for size before they are passed for use in the sand or gravity die foundries.

The comparatively small sand foundry specializes in the production, on a limited scale, of castings in high strength alloys; here, also, development work is carried out prior to large-scale production in the gravity die foundry.

Moulds are filled by hand ladle from a line of bale-out holding furnaces of 300 lb. and 350 lb. capacity, which are fed from the main remelt department at one end of the bay. The castings are rough viewed before they are passed into the fettling shop.

By re-arrangement of equipment in the space available, the output capacity of the main gravity die foundry has been practically doubled. This has been achieved mainly by the re-positioning of the holding furnaces into four rows, which allows the casters free movement between furnaces and dies, and at the same time gives sufficient gangway space for the travel of the untrimmed castings.

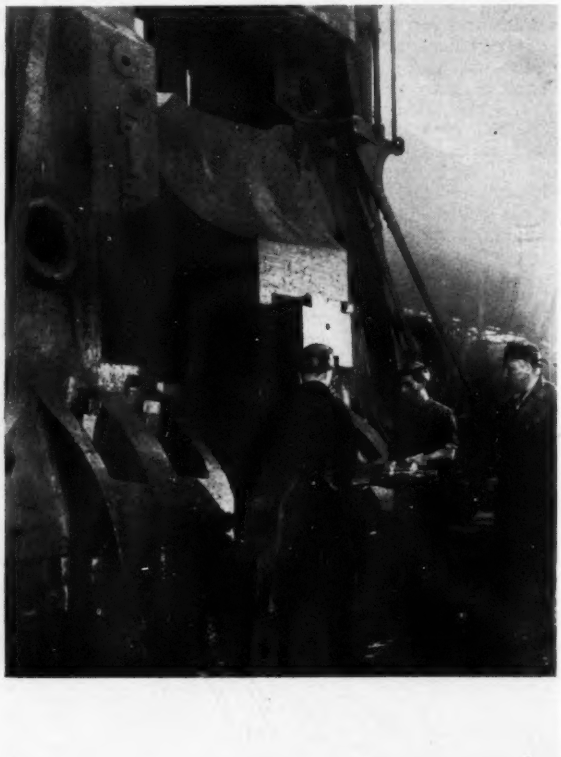
There are in this department 34 furnaces, all being oil-fired and of the single bath type, except in that part of the shop where large castings are produced; here, twin baths are installed. Services for all four rows of furnaces are enclosed in two trenches under the floor and are easily accessible; oil pipes and air ducts are both placed on top of the flue carrying off the products of combustion; in this way, the oil and air are preheated before burning, and a substantial saving in heating costs is effected.

As in the sand foundry, the holding furnaces are filled with metal from the main remelt department, using ladles of 600 lb. capacity. An overhead crane is used for handling both ladles and dies.

A corner of the heat-treatment department. Pistons, after removal from the solution treatment furnace, are being lowered into a quench tank

Forging an airscrew blade on the 45,000 lb. pneumatic hammer

[Courtesy Esso Petroleum Co. Ltd.



As the products of the foundry are of great variety, ranging from small electrical accessories to large air frame components, several types of die are required. These are either manually or mechanically operated, the latter including very large dies in which the angle of tilt is automatically changed during pouring and the mould parted pneumatically, or by rack and pinion.

In the fettling shop, which is situated next to the main gravity die foundry, the sand castings and gravity die-castings are passed along separate lanes to undergo progressive finishing operations. Here, they are also inspected for surface defects before they are passed for heat-treatment.

Pistons are gravity die-cast in a separate building from that housing the sand and main gravity die foundries with their remelt, core preparation and fettling departments. In the piston foundry, remelting, casting and fettling are carried out in one bay, the equipment being arranged to make the best use of available space by providing an efficient, smooth-running production line.

Metal brought by truck from the metal stores is remelted in a coke-fired reverberatory furnace of 30,000 lb. capacity, adjacent to which is a furnace of similar design used for the production of "hardeners" (alloys rich in certain constituents for addition to pure aluminium) for both remelt departments.

The remelted metal is transferred by overhead crane to two rows of gas-fired holding furnaces of 350 lb. capacity from which the gravity dies are filled.

As the pistons are removed from the dies, they are placed in bins resting on a roller conveyor that links up the casting tables with machine test, fettling, and heat-treatment departments. In the stringent machine test, sample pistons from every bin are machined on a lathe, using a diamond-tipped tool, which gives a very smooth surface on which the slightest defect may be seen. When each batch has been examined in this way, it is moved forward for fettling or rough turning, then passed through a hatchway into the heat-treatment department, which occupies the next bay.

According to requirements, castings in the heat-treatable alloys are given either solution treatment ("W" temper) or a full heat-treatment ("WP" temper), which includes both solution and artificial ageing treatments. Solution treatment is carried out by heating the castings for several hours at temperatures ranging between 425° and 535°C., and then quenching in water or oil. Five pit-type furnaces are used, the castings being stacked on cradles which are handled by an overhead crane. Artificial ageing (or "precipitation" treatment) takes place in two horizontal furnaces at much lower temperatures (between 150° and 235°C.), after which the charge, held in horizontal cradles, is allowed to cool off in air.

Part of the forge, showing some of the drop stamps and pneumatic hammers

After heat-treatment, castings are removed by fork-lift truck to the inspection department.

All castings are carefully inspected, some are checked for size on special jigs, and those that are required to hold liquids are tested for porosity (by filling them with dyed spirit).

Castings that are to be used in aircraft, and are, therefore, subject to A.I.D. inspection procedure, are given an X-ray examination. For this purpose, three 220 kV sets are provided, two being used for radiography and the third for visual radiological examination on a screen.

As the castings pass inspection, they are removed to the despatch department in the same building, where they are packed ready for transport by road.

Foundry Products

Castings form the greater proportion of the works present-day output. They are produced in the Noral alloys by sand and gravity die-casting methods, and vary widely in design and application. Alloys having silicon as chief alloying constituent are among those most extensively used, for they are well known for their excellent casting properties, which are combined with good resistance to corrosion; Noral 160, for example, which contains 12 per cent silicon as the only alloying element, is used extensively for sink units, engineering components and chemical plant fittings, while Noral 162, which contains also nickel, copper, and magnesium, is the alloy in which most pistons are cast. Aluminium-copper alloys, with and without other elements, are found useful for their high strength and good machining properties; for example, castings in Noral 226, with 4½ per cent copper, include stressed air frame components. Noral 350, containing 10 per cent magnesium, is one of the group of aluminium-magnesium alloys which combine excellent resistance to marine exposure with high strength and ductility; it is used principally in stressed air frame parts, and also marine fittings and propellers.

Forge

The forge was built in 1937, and occupies a single building, in which are housed fettling, heat-treatment, etching and inspection departments, in addition to the forging equipment with its accompanying preheating furnaces.

Forging stock is produced wholly within the company; its grain size is fine enough to ensure that the finished forgings have the required mechanical properties.

Stock is preheated in furnaces of several types, at temperatures between 440° and 475°C., depending on the alloy. The extensive preheating equipment includes gas-fired furnaces of various designs, and electrically-heated conveyor furnaces. In each, the temperature of the stock is controlled within fine limits.

Pre-forging of the stock into "dummies," required for all but the very smallest components, is usually done on quick-acting pneumatic hammers of 5 to 10 cwt. rating. Dummies for some classes of work, such as propeller blades, however, are prepared in forging rolls. These preform the blades rapidly and efficiently by progressively squeezing the metal into shape, and replace difficult and tedious hand forging on one of the pneumatic hammers. All dummies are reheated before the next forging operation, for which drop stamps, presses or pneumatic hammers are used.

Drop stamps ranging from 10 to

30 cwt. rating are available for the production of small die forgings, which include motor car connecting rods and small cycle parts. Where small pressings are required, however, a 200-ton friction screw press is used, while medium-sized pressings, such as spin pots for the rayon industry, require the additional power of the 750-ton vertical hydraulic press. For still bigger pressings, two hydraulic presses of 1,000 and 1,200 ton rating are installed; the former has both vertical and hydraulic rams, so that, in addition to producing articles that require deep pressing, it can be used for upsetting operations such as that required to form the hub on certain types of airscrew blade. All airscrew blades and very large air frame components are forged on three pneumatic hammers of 6,000, 20,000 and 45,000 lb. rating, the last being one of the biggest forging hammers of its type in the world.

Recently installed is a 4,000-ton hydraulic press for producing closed die forgings, hand forgings, and for pre-working of forging stock. With this equipment in combination with that which was already existing, this department is in the unique position of being able to manufacture closed die forgings of up to 1,000 lb.

After the final forging operation, components are delivered by truck to the fettling department, where flash is removed by clipping presses, band saws and grinders. Then, after an intermediate inspection, the material is ready for heat-treatment.

Two vertical electrically-operated furnaces, together with quench tanks, are provided in the forging bay, and components are heat-treated here and in the foundry heat-treatment department, where facilities are provided for handling forgings of all sizes. Airscrew blades, for example, are suspended vertically from "spiders," and smaller forgings are stacked in cages. Heat-treatment technique is very similar to that used for castings, except that forgings, size for size, generally require a shorter time in the furnace. Forgings are conveyed to the heat-treatment department by truck and then returned for etching, if the customer requires it.

The small etching plant in the forging bay comprises three tanks filled with a hydrochloric-hydrofluoric acid mixture, nitric acid, and hot water respectively. Into these the forgings are dipped in sequence, and after the last water rinse they are finally inspected for size and surface irregularities before being sent to the general despatch department.

Forge Products

Although nowadays forgings represent a comparatively small proportion of the total output of the works, they are produced in considerable variety and range from airscrew blades to small cycle components.

Of the several Noral forging alloys, those which find the widest application have copper as their chief alloying constituent, with varying additions of other elements such as magnesium and manganese. Noral 26S, for example, is used in such forgings as stressed air frame components, motor car connecting rods, and mining equipment. Other alloys of greater strength contain up to 8 per cent of zinc, with smaller proportions of other elements; one of this group, Noral M75S, is used principally for heavily-stressed undercarriage components. The alloy Noral 38S, which contains 11½ per cent of silicon and 1 per cent each of magnesium, copper and nickel, is not as strong, but retains its strength well at elevated temperatures, and has a low co-efficient of expansion; it is used chiefly for cylinder barrels of aircraft engines, and for pistons. Of other forging materials, commercially-pure aluminium (Noral 2S) is used where high strength is not required and lightness and anti-corrosive properties are of considerable value — in pressed holloware or spin pots for the rayon industry, for instance.

Conductor Accessories

Conductor accessories, chiefly those which are used on the aluminium cable steel-reinforced type of high tension line, have been manufactured by Northern Aluminium Company for over thirty years, but it was not until 1950 that a special department to deal with these products was set up in the Birmingham works.

These accessories are of a great variety of types, and may be cast, forged, or extruded and welded.

The cast and forged light alloy components are made in the respective departments within the works, and the conductor accessories machine shop carries out all the appropriate welding, final fettling and machining.

In addition to this class of work, facilities for providing other forgings and castings in the machined condition are offered to customers.

Toolroom

As already stated, the toolroom makes all the forging and casting dies that are required by the forge and foundries. It is one of the largest and best equipped in the industry for carrying out this class of work. Gravity dies are machined from iron castings roughly approximating to the final shape required.

Forging dies are cut from hardened and tempered forged steel blocks, and machinery is available for sinking impressions in die blocks up to 9 ft. long and weighing eight or nine tons.

Technical Department

At every stage in the production of castings and forgings, strict metallurgical control is maintained. The technical department, which takes care of this, is centralized within the works, and here, metal needed for melt make-up is requisitioned and the composition of all raw materials, as well as alloys produced by remelting, is checked by chemical (including absorptiometric) and spectrographic methods. Plant control personnel, who supervise all stages of manufacture, are responsible for the macro and microscopic examination of components during development and actual production. Specially cast test pieces and specimens taken from forgings are tensile tested to keep check on heat-treatment and the quality of product generally, while a sand testing department, by daily routine sampling, keeps rigid control of the quality of core and moulding sands.

Readers' Digest

VACUUM PUMPS

"Compressors and Vacuum Pumps and Their Lubrication." *Published by Shell Petroleum Company Limited, 1 Kingsway, London, W.C.2. Pp. xiii + 225.*

WITH the increasing range of special purpose lubricants being marketed, and the wider usage of vacuum technology, the maintenance of equipment such as compressors and vacuum pumps involves a degree of specialized knowledge that has not always been available to the laboratory or works engineer. To meet the requirements of such technicians for specific information on the types of lubricants best suited to particular applications in this field, the Shell Petroleum Company has published a book, "Compressors and Vacuum Pumps and Their Lubrication," that should prove valuable in many industries.

It deals first with basic information concerning gases and liquids, outlines the principles of lubrication, and goes on to deal with the construction and control of reciprocating compressors, and the method of application of lubricants to this type of equipment. Further sections deal with the performance and selection of cylinder oils and of bearing lubricants. Air filtration and purification are considered, and three more sections deal respectively with rotary-displacement compressors, aerodynamic compressors, and high-vacuum equipment. Two final sections deal with Shell products for this type of service.

Copies are available in the U.K. from Shell-Mex and B.P. Limited, Shell-Mex House, Strand, London, W.C.2, and in other countries from the local Shell company.

Finishing Supplement

Automatic Cadmium Plating

FROM small beginnings in 1948 at a small factory in Chislehurst, specializing in cadmium and zinc plating for the radio and electronic industry, Modern Electro Plating (Kent) Co. Ltd. rapidly found that their increasing volume of business made it necessary to extend factory floor space, and eventually it was decided to look for new premises. A suitable site was found in 1952 at Slade Green, Kent, and the company went into production there at the beginning of 1953. Some 12 months later, an additional plating shop, polishing shop and stores were built on to the existing factory.

In September, 1957, it was felt that automation could be usefully applied to give the necessary capacity required to accommodate the expanding flow of business. British, German and American electroplating supply houses were approached for the design of automatic plant suitable for the particular requirements of the company, and finally W. Canning and Co. Ltd., of Birmingham, were asked to undertake the design of the plant.

Whilst the plant was still on the drawing board, the radio trade suffered a serious recession, but the policy of the firm has always been one of progress, and at no time was consideration given to the idea of delaying installation. The plant was delivered in May, 1958, and within six weeks was in full production.

To house such a machine, an additional new factory of 6,000 ft^2 was planned, incorporating acid-resisting floors and special methods of effluent disposal to handle the large quantities of water required by such a plant. A unique feature of this building is that vans are able to drive straight through, thus being able to load work direct from the automatic plant, thereby reducing handling to a minimum and facilitating quicker delivery times.

The new unit is, in fact, the first production example of an automatic plating plant employing a completely hydraulic system of operation. Hitherto, operation has been by either electro-mechanical or electro-hydraulic systems. Each system worked well within its limitations, but the new development is probably the most interesting advance in operation since automatic plants were first designed.

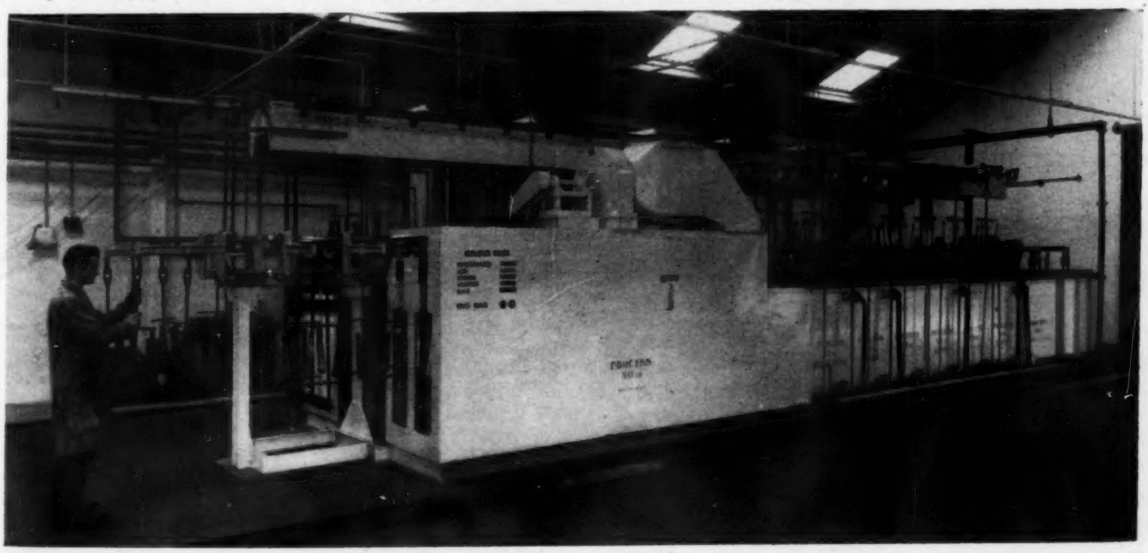
The new plant has a compact centre section which dispenses with the normal permanent central structure extending above tank level. The centre unit consists of a simple system of hydraulic lifting cylinders pushing underneath the carriage, so raising it to give the required clearance for the transfer of jigs from tank to tank. The lifting cylinders operate on a low pressure hydraulic system through mechanically-operated valves, and are interlocked by a rack and pinion mechanism which ensures that they are permanently in phase. There are no flexible connections, the pressure and return lines being carried by telescopic tubes.

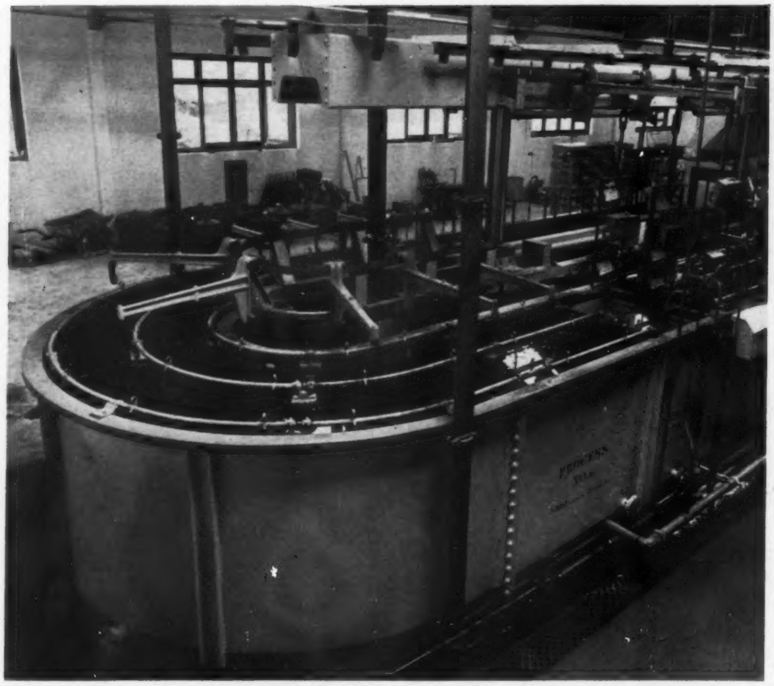
Transfer of plating jigs is effected by hydraulically-operated traverse bars —conveyor chains, counter balance weights and solenoids are entirely dispensed with, and the number of limit switches used has been reduced to one single unit, therefore the sources of possible de-synchronization are eliminated. The carriage itself is notable for the clean line on the upper surface and its simple yet rigid construction. As will be readily understood, traverse bars are not subject to the stretch which is sometimes troublesome with a system of chains; therefore, the whole system is fully positive in operation. Each transfer can be independently adjusted as the position of the tanks in the plating process requires. The hydraulic gear which operates this lift and traverse mechanism is carried on the centre structure independently of the process tanks, and is powered by a motor unit remote from the plant. The only parts of the unit which overhang the tank in any way are the work arms which carry the plant jigs. This is, of course, an obvious advantage from the point of view of reducing corrosive attack on operating mechanism, carriage gear, and supports. It also fully eliminates the possibility of solution contamination by oil dripping into it The tanks around the plant are fabricated in units which are designed to enable them to be easily withdrawn from the process line at any time in order to enable inspection and maintenance to be carried out.

The process sequence is under the control of an electronic timer, thus it will be seen it is impossible for the plating process to go out of any sequence once it has been set.

In order to facilitate transportation and erection, the centre unit containing the operating mechanism was built up from sections easily coupled together to form the complete unit. On despatch from the Birmingham assembly shops of W. Canning and Co. Ltd., the sections were despatched independently as separate units. They

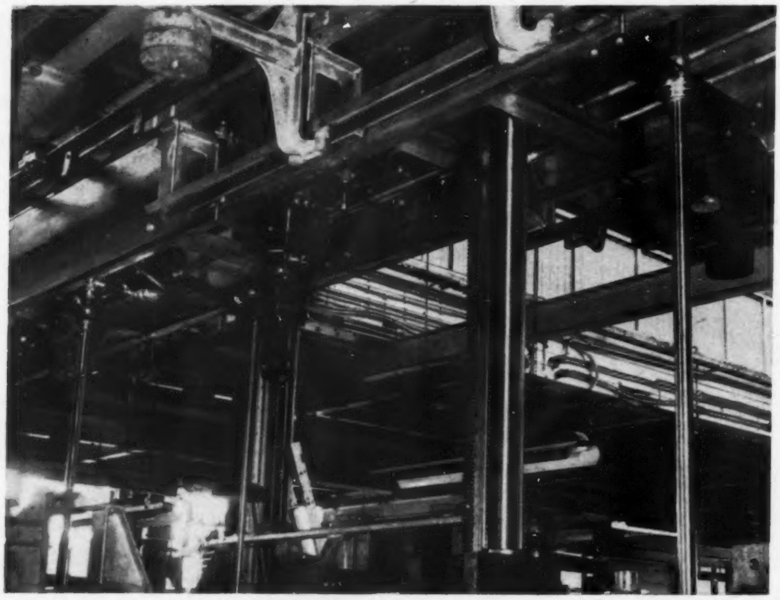
The hydraulically-operated automatic cadmium plating plant, installed at Modern Electro Plating (Kent) Co. Ltd.





The cadmium plating section of the hydraulically-operated automatic plating plant

The centre unit showing the carriage in the raised position. One of the hydraulic cylinders with its rack is in the foreground. Two telescopic feed pipes can be seen, one on each side of the hydraulic cylinder. In the left centre are the traverse valve and its operating mechanism



were then re-assembled on site in the minimum of time and with the minimum amount of labour. The process tanks were supplied, as previously mentioned, in compact units in suitable sizes for easy handling. Handling and transport have been kept very much in mind in the design of these new units, and they are able to be broken down into sections in the order of 12 ft×6 ft×3 ft. The plant was delivered in May, 1958, and in less than six weeks was erected by Modern Electro Plating themselves, tested, and had settled down into full routine production.

Careful time and motion study has been carried out, and the new installation has fully justified all expectations. In certain instances, time and costs per batch plated have been reduced by as much as 50 per cent.

Bright Tin

DEVELOPED by the Tin Research Institute a short time ago, and established on both a laboratory and a production basis, a bright tin plating process is now being made available commercially. The most important constituent of the bright tin plating process is the brightener, made from wood tar by a special process. A revivifying agent has also been developed for addition to an old bath when a decline takes place in the brightness of the deposits produced, an occurrence well known with other bright plating processes.

The brightener and the revivifying agent for this purpose, manufactured by Shirley Aldred and Co. Ltd., are now available in England and Wales from Sonic Engineering and Equipment Ltd., 120-130 Parchmore Road, Thornton Heath, Surrey, under the name of "Brytin," together with full technical service. The composition of the "Brytin" bath is as follows (gm/L or lb/100 gal.): stannous sulphate (B.S. 1468) 100 (55 tin), sulphuric acid (S.G. 1·84) 140, "Brytin" brightener 80. Temperature—room; current density—15 amp/ft^2 to 40 amp/ft^2 for still work, but very much higher rates are possible with movement of the work. Anodes—rolled or cast from refined tin (not less than 99·75 per cent).

A rubber-lined or P.V.C.-lined tank is required for the process, and movement of the cathode is usually desirable. The bath may be used for vat plating or for barrel plating. After plating, the work requires a cathodic treatment—such as 10 sec. at 6 V in 3 per cent trisodium phosphate at 80°C.—to ensure full brightness.

The bright tin plating process has a very wide field of application, particularly for parts that are to be soldered. One of its main advantages is that the bright coating is not perceptibly marked with the fingers, whereas the chalky matte finish of the ordinary plating baths is easily disfigured.

Foam Control

AN antifoaming agent, named MS Antifoam Emulsion RD, which is a highly dispersible oil-in-water emulsion, is easy to use and quickly dispersed in cold water, has been introduced by Midland Silicones Ltd., 68 Knightsbridge, London, S.W.1. As well as having excellent thermal stability, it is effective in very small concentrations and may be added undiluted to foaming solutions.

Optimum concentration required for any system must be determined in practice, concentrations between 10 and 500 parts per million usually being used, and 200 parts per million is suggested as a starting point for trials.

For some systems the solvent Antifoam A, which has been available for some years, will still be found preferable, and will continue to be available.

Plating and Anodizing Rack Design

By H. KRAUS

Part II—Rack Materials

RACK coatings are used to protect a rack from the elements encountered in the plating cycle. The simplicity of the term is very deceiving, however, as ample design provisions must be made to allow for coating if success of the rack is to be ensured. Edges of the rack members must be kept round so that the coating will cover uniformly and no thin sections appear.

Another hazard in the use of coating is the fact that certain configurations of the rack may cause trapping of air or coating while the part is being dipped, with the subsequent possibility of the coating peeling or blistering in use. It must also be remembered that coating will build up dimensions and close drainage holes or other dimensional holes. These must be made oversize to allow for this condition. Many people like to see an extremely heavy rack coating. To the contrary, uniformity and completeness of coverage are much more important than thickness of coating. If the coating is chemically resistant to the solution it will perform this function whether it is extremely heavy or thin, as long as there are no blisters, pin holes, or air pockets. Thick coatings lose flexibility and often, due to internal forces, will tend to pull away from the base or to laminate.

Considerable thought must also be given to trimming of the coating. The rack maker is always faced with the decision of removing a lot of the coating from the contact area, or just a little. It is true that the smaller the amount of coating removed the less the plating build-up will be; but, at the same time, detrimentally, the less heat will be dissipated, thereby increasing the tendency to blister. A great deal of coating on the part also makes it difficult to rack the part. In the case of titanium tips, the decision is much simpler. Trimming the coating back a considerable distance from the edge of the tip prevents overheating of the contact and burning of the coating. It also prevents damage to the coating during racking, which is an important factor with titanium tips, as solution must never be permitted to penetrate to the aluminium interface. Anodizing solution which penetrates between the aluminium-titanium interface will immediately cause deadening of the contacts.

Rack Materials

Copper, steel, aluminium and titanium are the basic materials used in rack construction.

For rack frames, copper and some of its relatives, such as bronze and brass, offer the advantages of good conductivity, easy workability, and easy joining techniques such as soldering, brazing, and silver soldering. Some of the disadvantages of copper are that copper products are costly, offer poor strength, and are difficult, if not impossible, to heat-treat. When weight is a factor, or current requirements are low, steel is used in combination with, or as a replacement for, copper. The advantages of steel are its low cost, high strength, good weldability and ample supply, even in times of material shortages.

However, steel has a very low current-carrying capacity, is somewhat more difficult to work and, of course, is not a light material. Aluminium, which is almost always used for anodizing, has also been used for other rack construction. In anodizing, aluminium is ideal because it will not contaminate the solution, is not destroyed by the anodizing solution, and carries current well. When used in plating rack construction, it has the same advantages as in anodizing, with the unfavourable exception that it is quite soluble in alkalies and many acids, and is more difficult to work with. Aluminium welding techniques are difficult, and soldering of aluminium has only recently been successfully developed. Depending on the market, aluminium is close in cost when compared to copper. Also used in rack frame construction are such metals as stainless steel, Monel, even nickel and titanium. However, these are used only when corrosion requirements are extreme.

The consideration of material used for rack contact is similar to that used for the rack frame, with the exception that one more important consideration is usually given; that being flexibility or resilience of the part. Spring type phosphor bronze is the most widely used material for rack contacts. It has excellent resilience, good conductivity, and is the easiest with which to work. Stainless steel and spring-tempered steel are also used quite frequently. Spring-tempered steel is economical and makes an excellent contact, but its electrical resistance is relatively high, and corrosion resistance very low. Stainless steel, though a relatively poor conductor, has one advantage over any of the other materials, in that it can now be stripped easily of nickel and chromium deposits by means of new developments in chemical strippers which rapidly remove nickel and other metals plated over the nickel. Another point in favour of stainless steel is the fact that it does not accept plating as readily as the other materials. As a result, stainless steel tips are becoming increasingly popular. Titanium is in ever-increasing demand as a material for anodizing tips. It will not anodize, and it prevents streaking of parts in colour processes because it will resist attack by the bright dip and will not pit or absorb dye. Because of its good chemical resistance and resistance to accepting plating, titanium is also being used as a contact in electropolishing racks and plating baths. The high cost of titanium is still a factor, and limits its use mainly to anodizing. Titanium mills are continuously developing new methods of producing titanium and the price is dropping steadily. One other disadvantage of titanium is its high electrical resistance compared to that of copper.

The gravity contact is constructed of various materials. Conductivity, machinability, and chemical resistance are the only considerations in using one material over another. Copper products still lead in use because of the good conductivity factor. Steel is still the most economical and has good strength. Stainless steel, Monel, and other such alloys are frequently used because of their chemical resistance, but are more expensive and are poor in electrical conductivity.

A rack coating has the purpose of protecting the rack from chemical attack, protecting the solution from contamination by the rack material, and reducing the metal loss caused by plating on the rack.

Plastisol, which is the common name for various unplasticized polyvinyl chlorides, is the most accepted rack coating and the most universally used. Plastisols show good resistance to chemical attack in almost all plating and anodizing solutions, as well as pre-treatment or post-treatment cycles. In spite of wide claims, plastisols are not resistant to continuous exposure in degreasers. Short intermittent cycles are permissible. Other advantages of the plastisols are that they are easily applied and that, in the cured stage, they exhibit the physical properties of rubber, thus giving physical protection as well as chemical protection to the rack.

Other rack coatings often used are rubber, synthetic rubber, lacquers, polyesters, and silicones. These products are much more limited in their range of corrosion protection; in many cases they are more expensive and much more difficult to apply. They are used only when a particular phase of their chemical resistance is required due to an unusual treatment cycle.

The laws governing the use of inside anodes also apply to the auxiliary anodes. The only difficulty involved is that some of the anode material is almost impossible to cast and work with. Consequently, more workable materials must be used. The most ideal anode is still one made of the purest form of the metal to be plated. When that is not available, an insoluble anode having good anode characteristics is the most desirable. If neither of the aforementioned anode materials is suitable, then a soluble anode whose solubility products are not harmful to the plating bath may be used. Table I lists various types of materials which may be used for auxiliary anodes in various plating baths. (METAL INDUSTRY, 19 September, p. 237.)

Rack Construction

Methods of manufacture for any given item vary greatly, depending on the manufacturer's equipment and techniques, and it is impossible to state rules which can be followed by everyone. However, there are certain suggestions which may help those attempting to manufacture racks.

Whenever feasible, the rack frame should be constructed of one single piece with as few joints as possible. Wherever joints are required, both bolting and silver soldering or welding should be used and, in the case of aluminium, particular emphasis must be placed on good welds. When it is necessary that the hooks be separate from the frame, the former should be reinforced. Corners and tee-bars must also be reinforced in the same manner. Good engineering principles must be applied to the construction of the rack frame, keeping in mind that plating racks are subjected to static as well as dynamic forces, including many variations of temperature. Strong impact, accidental abuse, and jamming of a plating machine, represent other hazards to the rack.

Rack contacts should also be formed from one piece whenever feasible. Spring type contacts are continuously under strong load, and failure due to fatigue can easily occur. Conformity to proper bend radii will help to prevent early fatigue failures. Occasionally, a complete contact must be made by joining several pieces. The rivet is the best method of joining several pieces, and of joining portions of tips, as it makes the least bulky joint, avoiding coating difficulties. Welding or soldering of spring temper contacts must be undertaken with great caution, as overheating can destroy the spring temper of the contact material. In the production of anodizing rack tips, the small titanium tips are preferably joined to the aluminium tip by means of stainless steel rivets. The stainless steel rivets are used in lieu of aluminium rivets because the titanium tip is hard and will abrade the soft aluminium rivet material causing it to loosen.

Assembly of the contacts to the rack frame is accomplished by threading or bolting. Bolting is more advantageous than riveting, as it lends itself more readily to dismantling and repair. Further, bolted contacts make better contact, particularly when lock washers are used. After bolting, the contacts should be soldered to the frame to increase the conductivity between the frame and contact, and to decrease the possibility of loosening of the contacts.

Construction of the auxiliary anode should be kept as simple as possible. In most cases it is expendable, and, therefore, should be kept as inexpensive as practicable. The most successful auxiliary anode is supported by a separate frame, because it is easier to construct and more rigid, thus avoiding the possibility of contact with cathodic parts. The inside anode must be insulated carefully to prevent any shorts, using material which must withstand coating temperatures, has good strength, and does not absorb moisture.

Applying Rack Coatings

Plastisol does not differ widely from other types of cured organic coatings in its methods of application.

The basis metal must be properly prepared to accept the rack coating. Good adhesion is the only difficult thing to obtain when applying plastisol, and it is the preparation of the basis metal which is the greatest determining factor in the subsequent adhesion properties of the material. Electrocleaning, degreasing and etching may be used to give good pretreatment results; however, the combination of degreasing and sand blasting is unsurpassable. Sand blasting of metal members prior to plastisol coating should be a must if good adhesion is to be assured. Following the pre-treatment of the metal, plastisol primer is applied. The primer acts as the agent that bonds plastisol to the metal. Various types of primers are available. The choice depends upon the type of service in which the rack is to be placed. Some of the primers have better high temperature properties, others resist changes of temperature more readily, and some have better corrosion-resistant properties, which become important should damage to the rack occur.

The primer is applied by dipping, brushing, or sometimes spraying. It is then allowed to air dry and is cured at the recommended temperature, usually between 300-350°F. Following curing of the primer, the part is then preheated for the dipping operation. The preheat temperature determines the thickness of coating the part will pick up during dipping.

Often the preheat temperature and the curing temperature of the primer will coincide. After the part has reached the proper preheat temperature, it is dipped into the plastisol and withdrawn slowly to allow it to pick up the maximum amount of coating and decrease drips that are caused by fast withdrawals. After dipping, the coating is allowed to set slightly, and then it is cured for 30 min. at approximately 360°F. The curing temperature is determined by the type of coating used; however, curing at the upper limits of the curing range produces the maximum chemical resistance in the coating. If one dip should not produce sufficient thickness, the rack may be redipped after the part is brought up to temperature and before curing is completed. After redipping, the part is then cured at the recommended time and temperature.

Rack Maintenance

Much damage is done to plating racks due to improper storage when not in use. They are by nature bulky and difficult to stack and, consequently, care should be exercised when they are stored and ample room provided for storage. If injury occurs to the rack coating, it should be repaired immediately. There are many good patching devices now on the market. Although they are not as effective as a good rack coating itself, they will prevent serious damage on a temporary basis. Plating build-up on contact tips should be removed frequently, as it will tend to peel the coating from the contacts and cause progressive damage to the rack. In connection with the aforementioned, empty contacts on racks in the plating cycle should be held to a minimum to avoid undue build-up with detrimental results. Loose frames and other members of the rack must be tightened, if possible, or supported so that the frame of the rack will not move and be damaged further when in use.

STANDARD SPECIFICATIONS

Determination of Compressibility of Metal Powders. (*B.S.* 3029:1958.) *Price* 3s.

COMPRESSED metal powders possess many unique properties—e.g. in their varied forms they contribute to the extreme hardness of tool steel, and to the essential porosity of certain types of bearings.

The three clauses of this method for determining the compressibility of metal powders specify: the die and set to be used (together with an illustration), the method of determining the weight of powder required, complete details of the "procedure," and the manner of expressing the result obtained.

Copies of the above-mentioned standard may be obtained from the British Standards Institution, 2 Park Street, London, W.1.

Men and Metals

It is announced that the Lord President of the Council has appointed **Vice-Admiral Sir Frank Mason,** K.C.B., M.I.Mech.E., M.I.Mar.E., to be a member of the Council for Scientific and Industrial Research. Sir Frank Mason is a director of Metal Industries Limited and H. W. Kearns and Company Limited, and consultant to Metropolitan-Vickers Electrical Company Limited Before his retirement from the Royal Navy in 1957, Vice-Admiral Mason was Engineer-in-Chief of the Fleet.

Managing director of West Instrument Limited, **Mr. J. A. Hartnett** has been visiting the company's customers in Italy.

Buying controller of the British Oxygen Company Limited, **Mr. C. F. Huebner** has been elected President of the Purchasing Officers' Association for 1958-59.

News from Foundry Services International Limited is to the effect that **Mr. G. J. N. Cherry** has been appointed a director of the company.

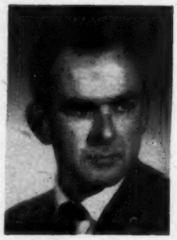
One of the best known personalities in the field of metallurgy in this country is **Dr. Harold Moore,** C.B.E., Ph.D., D.Sc., F.R.I.C., F.Inst.P., who has recently been elected an honorary member of the Iron and Steel Institute, of which he has been a member for 57 years. Dr. Moore is a past-

president of the Institute of Metals, and was awarded the Institute's Platinum medal. He was also the first President of the Institution of Metallurgists, is a Founder Fellow of the Institute of Physics, and has served on the councils of the Royal Institute of Chemistry and the Faraday Society.

It has been announced by Head Wrightson and Company Limited that **Mr. Norman Addison,** who has been commercial director of Head Wrightson Iron Foundries Limited since its formation in 1957, has now been appointed director and general manager of that subsidiary company. Mr. Addison commenced his commercial training with the company in 1934.

Appointed managing director of G. A. Harvey and Company (London) Limited, **Mr. H. E. Cooper,** B.Sc., joined the company in 1945 as consulting engineer to the board of management, and was appointed to the board of directors in 1946. **Mr. P. T. Bliss,** who retires in December after 50 years' service with the company, is succeeded as sales director by **Mr. I. A. Marriott,** who has been deputy sales director since June, 1958.

Son of the late Col. W. C. Devereux, C.B.E., founder of the Almin Group, **Mr. Robert Wayne Devereux** has been appointed sales manager of Warwick



Production Company Limited. Mr. Devereux joined the company in 1957 after service with various other companies of the Almin Group.

Formerly a lecturer in Natural Sciences at Cambridge University and a Fellow of Trinity Hall, Cambridge, **Dr. R. F. Webb,** B.Sc., Ph.D., has joined the staff of CIBA (A.R.L.) Limited, where he will direct the activities of a number of specialist groups engaged in long-term research on new plastics materials.

Recently appointed as works engineer of Alfred Case and Company Ltd., **Mr. G. R. Moore,** A.M.I.PlantE., was previously works engineers' superintendent at Lockheed Hydraulic Brake Company Limited. He joined that company in 1942, and was a technical assistant and maintenance foreman before becoming superintendent.

Resigning his post as Midland area manager of Nicholson and Rhodes Limited, **Mr. Hugo McGhee** is continuing his association with the scrap metal trade as managing director of

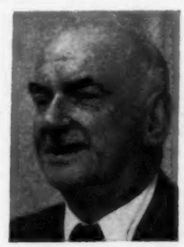
Hugo McGhee (Metals) Limited. Mr. McGhee was educated in Dublin and joined Nicholson and Rhodes Limited seven years ago. He was representative for that firm in the Lancashire area for two years before taking over the Midland area. He is this year's chairman of the Non-Ferrous Club.

In Copenhagen last week, **King Frederik of Denmark** presented the Niels Bohr Medal to **Sir John Cockcroft.** This medal was awarded to Sir John for outstanding scientific achievements in the field of peaceful use of atomic energy.

It is learned from the British Aluminium Company Limited that **Mr. E. A. Langham,** the company's resident representative in Australia, will be returning to the United Kingdom early in 1959. He will be succeeded by **Mr. G. A. Daniels. Mr. J. W. G. Emery,** at present Malayan area representative, will become Pacific area representative on the return of Mr. Langham.

Two additional technical representatives have recently been appointed to the outside sales staff of the retaining ring division of Geo. Salter and Company Limited. **Mr. George Taylor** will cover the Midland region. He started with the company 26 years ago. **Mr. C. D. McWhinnie** will be based on the company's Manchester office. He has had considerable engineering experience in the fields of jig and tool design, light mechanical handling and contractors' plant.

Joint managing director of The Wolverhampton Metal Company Limited, and a director for many

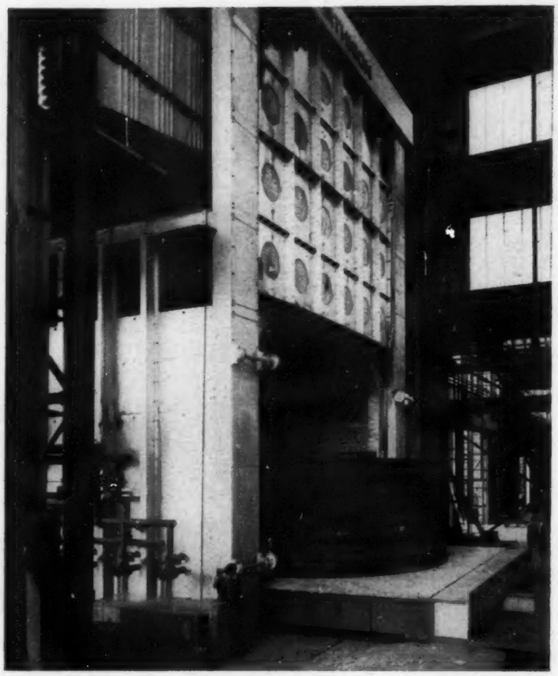


years, **Mr. J. H. Furnival** has also been appointed vice-chairman of the company.

At the meeting of the Scottish branch of the Institute of British Foundrymen, held in Glasgow on Saturday of last week, **Mr. James Ferguson** was appointed President of the branch for the year 1958-59. Mr. Ferguson is managing director of the Bonnybridge iron foundry of Lane and Girvan Limited. He is also a former President of the Falkirk branch of the Institute of British Foundrymen.

Elected Fellows of The Institute of Physics at the meeting of the Institute last week were the following:—**Mr. J. H. Calderwood, Mr. R. C. Faust, Mr. H. G. Jones, Mr. C. R. Tottle, Mr. M. J. Tucker,** and **Mr. T. H. Tyler.** In addition, 43 associates, 68 graduates and 38 students were elected.

Heat Treating Large Vessels



"Universal" heat-treatment furnace at the works of Head Wrightson Teesdale Limited, designed and built by John Mathison Limited, for the treatment of heavy vessels

DESIGNED and installed specially to meet the exacting heat-treatment requirements for large nuclear power vessels, a large furnace has been installed at the works of Head Wrightson Teesdale Limited, by John Mathison Limited, of Hutton Hall, Guisborough, N. Yorkshire. The shop in which this furnace has been installed was designed for the production of heavy fabrications for nuclear engineering, and represents one of the most modern plants of its kind.

The furnace, named the "Universal" heat-treatment furnace, is designed to cover the full range of treatments of vessels from 200°C. up to 900°C.; and throughout the range of 200° to 700°C. advantage can be taken of the high speed recirculation of the hot products of combustion.

Four zones are arranged to operate from indicating controllers, each zone having a bank of four vertical flame burners with variable flame length; these burners are of the internal mix turbulent type, in which the gas and preheated air for combustion mix tangentially prior to passing into the heating chamber.

The furnace is capable of treating vessels 20 ft. in diameter, and loads up to 100 tons, and in order to accommodate these cylindrical vessels, it was decided in the original design to depart from the modern trend of flat suspended crowns and incorporate a sprung arch of almost semi-circular construction; the enormous span of this arch—namely 29 ft. 4 in.—necessitates the use of "Nettle D" high alumina refractories of great mechanical strength, together with perfect shapes.

Titanium Springs

AT a recent Technical Forum organized by the Coil Spring Federation Research Organization, **Mr. A. V. Jobling** asked if the Forum considered that titanium had any advantage over stainless steel, and did a low modulus of rigidity have any detrimental effect on the design of springs?

Replying, **Mr. J. A. Roberts** (technical manager, Herbert Terry and Sons Ltd., Redditch) said titanium was quite a new departure for spring materials; there had not been much used up to the present, but his own company had carried out some investigation on I.C.I. 314A alloy. The advantage was extreme resistance to corrosion compared with austenitic stainless steels. The modulus of rigidity appeared to be of the same order as that of the austenitic steels, i.e. about $9{\cdot}2\times10^6$ lb/in^2. He expressed the view that a lot of work had still to be carried out, and through investigations taking place at C.S.F.R.O. knowledge would be increased.

Mr. F. Gartside (technical manager, The Tempered Spring Co. Ltd., Sheffield) said that not many springs had so far been manufactured from titanium, but the fact that the modulus of rigidity was lower than that of steel would mean that from the design aspect it could affect such things as natural frequency of the spring.

Mr. J. K. Bache (technical director, Geo. Salter and Co. Ltd., West Bromwich) added that the natural frequency would not only be affected by the fact that the modulus was lower, but also by the lower density.

Mr. R. Haynes (director of research, Coil Spring Federation) said his own experience had been with 318A alloy, which was hard drawn, as against the heat-treated 314A material used by Mr. Roberts. The rigidity modulus for the former was in the region of 6×10^6 lb/in^2. In general engineering, high modulus materials were desirable in order to give rigidity to structures, but in the case of springs low rigidity was an advantage, since less material was needed for a given deflection compared with a steel spring. This, coupled with a lower density, was a weight saving factor of advantage to the aircraft industry.

Dr. R. Genders thought titanium having high elastic properties would be of great use in the future for the manufacture of springs.

Mr. Roberts, referring to the weight aspect, warned that though a saving in weight was obtained by reducing the number of coils and by the lower density, due to the latter, one would have to increase the wire size to combat the lower natural frequency.

Mr. Haynes agreed and said he had requested Dr. Gross to undertake a design study on titanium for springs in order to make a comparison with stainless and other steel springs, and the results of this investigation would be issued to members of C.S.F.R.O.

Dr. Genders added that the drawing of titanium wire was rather difficult.

Mr. P. R. Pashley (Temco Ltd.) reported having drawn titanium to 0·010 in., but trouble had arisen from galling.

Abrasive Cutting

UNDER this heading on page 198 of our issue of 5 September, a description of the Trennjager friction cutting machine appeared. This machine, which employs a steel blade, relies on friction cutting for its performance and does not use abrasives or abrasive discs.

Industrial News *Home and Overseas*

Packaging

A new type of package is to be marketed in this country at the beginning of the coming year by **Iridon Limited,** one of the Commercial Plastics group of Companies. With the registered trade mark of "Cubitainer," this pack consists of an outer corrugated cardboard cube which supports, and protects, an internal, semi-rigid polythene container.

Among the many possible uses for this type of container which are suggested are included the following:—adhesives, aluminium powders, metal cleaners, mercury, resins, solder fluxes, zinc chloride, and zinc sulphate. A useful leaflet descriptive of this new packaging is distributed by the company.

Castings for Scotland

Speaking at a meeting of the Scottish branch of the Institute of British Foundrymen on Saturday last, **Mr. James Ferguson,** President of the branch, said that far too many castings which could be produced in Scotland were being imported from England. He spoke of the potential market for Scottish foundrymen in the production of non-ferrous die-castings and high-duty castings for the motor, aircraft and electrical industries.

Mr. Ferguson also said that Scottish foundrymen should familiarize themselves with new products and techniques if they were to hold their traditional place in the production of castings.

Change of Name

It is reported that the name of "The Aerograph Company Ltd." has now been changed to **The Aerograph-DeVilbiss Company Ltd.,** in order to tie-up more closely with the symbol "Aerograph-DeVilbiss," which has long been famous as denoting the company's spray painting equipment. The registered trade mark remains the same.

Institute of Metals

Under Section 16 of the Finance Act, 1958, the membership subscriptions of certain societies approved by the Inland Revenue are deductible from the emoluments of any employment to be assessed for tax if deducted out of those emoluments and the activities of the society are relevant to the employment.

We are informed that the Institute of Metals has now been approved by the Inland Revenue as a Society coming within the terms of this Section of the Act. The effect of this decision is that members of the Institute may claim tax relief on their annual subscriptions provided that the activities of the Institute are relevant to their employment.

Members of the Institute are reminded that the new financial year of the Institute began on September 1 last, and that membership elections take place frequently during the year.

A Repeat Order

Following the success of the initial equipment supplied, **Wild-Barfield Electric Furnaces Ltd.** have received a repeat order from Wellworthy Limited, of Lymington, Hants., for a gas carburizing installation operating on the drip feed principle with "Carbodrip." The furnace has a usable work space 24 in. in diameter and 34 in. in depth, and will be employed for gas carburizing gudgeon pins

An Autumn Meeting

On November 5, 6 and 7 next, the **Institute of Welding** will hold its Autumn Meeting and Annual Dinner. The latter event will take place at the Park Lane Hotel on November 5, and the principal guests will include the Rt. Hon. Aubrey Jones, P.C., M.P., Minister of Supply, the Rt. Hon. Lord Coleraine, P.C., and the Bishop of Kensington. The Autumn Meeting will commence at 10 a.m. on the following day with the Presidential Address, and afterwards by technical sessions. In addition to the technical sessions, various works visits have been arranged to The British Aluminium Company Ltd., at Chalfont Park; British Oxygen Gases Ltd., at Cricklewood; Hancock and Co. (Engineers) Ltd., at Croydon, and Murex Welding Processes Ltd., at Waltham Cross.

An Agreement

It is understood that **Imperial Chemical Industries Limited** has reached an agreement with the Czech patentees of the carbon dioxide/sodium silicate process for making foundry moulds and cores which promises to clear the way for further development of this process in Britain. The process has already, it is stated been fairly widely accepted into foundry practice in this country, but uncertainties surrounding the future of British Patent No. 654,817 may have hampered its full development here. This patent lapsed in 1953, and an application which was made in 1954 by the patentees (Vitkovicke Zelezarny Klementa Gottwalda and Dr.-Ing. Lev. Petrzela, of Czechoslovakia) for its restoration is at present before the British Patent Office.

By an agreement with V.Z.K.G. and Dr. Petrzela, I.C.I. has secured an exclusive licence under the patent, if restored, with the right to grant sub-licences, and these will be offered to the foundry trade free from royalty. Independently of the restoration of the patent, I.C.I. has secured full access to all the technical information at present in the possession of Z.V.K.G. and Dr. Petrzela, and any that becomes available from their continuing research work on the process in Czechoslovakia. This agreement promises to release much valuable information to the foundry trade in this country.

A Birmingham Event

At the annual ball of the **Royal Metal Trades Pension and Benevolent Society,** held on Thursday of last week at the Grand Hotel, Birmingham, the guests of honour were the Lord Mayor and Lady Mayoress of Birmingham, Ald. and Mrs. Donald Johnstone. The board of management was represented by Col. Marcus B. P. Steddall, and the general secretary, Mr. L. H. Lindsay, was also present. A further noted figure in the metal trade who was present was Mr. Edgar N. Hiley, the secretary of the National Brassfoundry Association and present Mayor of Solihull.

The society, which carries on extensive work in providing pensions and grants for employees in the metal trades who are not otherwise provided for, is supported by voluntary contributions and donations from industry, and this annual ball is one of its efforts to raise further income to meet the considerable demands on its funds. Another event, held three weeks ago, and to be held annually in future, is a golf tournament, at which £103 towards the funds was raised.

A Removal

Information from **Protolite Limited** is to the effect that on October 27 next they will be transferring their main office from the West Central District of London to the premises of the parent company, Murex Limited. As from that date, therefore, the address of the company will be Rainham, Essex. The telephone number will be Rainham, Essex, 3322.

Protolite Ltd. intend to retain a South Region area office at their old address—Central House, Upper Woburn Place, London, W.C.1, and members of the London area sales staff may be contacted at that address.

New Company

It has been announced that a new company, called **Vickers-McKay Ltd.,** has been formed by The McKay Machine Company of Youngstown, Ohio, U.S.A., Vickers-Armstrongs (Engineers) Ltd., and Rockwell Machine Tool Co. Ltd., to manufacture in this country and market throughout the world a wide range of McKay machinery.

The registered office of this company will be at Vickers House, Broadway, Westminster, London, S.W.1, and the manufacture of this machinery will be carried out at the works of Vickers-Armstrongs (Engineers) Ltd. Sales will be carried out by the Rockwell Machine Tool Co. Ltd.

Northern Representatives

A member of the Amber Group of companies, **Causeway Reinforcement Ltd.** announce that they have appointed William Dickinson and Co. Ltd., of Proctor House, Newcastle-upon-Tyne, as Northern representatives for "Hexmetal" armouring for roads and linings in oil refineries and all types of industrial plant.

Sales Reorganization

Due to the growth of their industrial motor business, **Crompton Parkinson Ltd.** announce that Mr. P. D. Osborn, B.Sc., A.M.I.E.E., will now assume complete responsibility for the sale of motors produced at their Guiseley factory. Mr. C. J. Teasdel has been appointed product sales manager, Chelmsford machines.

Instruments in Industry

A series of leaflets with the above heading has been published by **Evans Electroselenium Ltd.,** in which some of the instruments for use in the metals industry are listed, and the leaflets offer a comprehensive guide to determinations which can be achieved by those instruments to the industries concerned.

The company has also produced a series of detailed method sheets for use with the "Eel" absorptiometer, the flame

photometer, and the colorimeter. All these publications may be obtained on application to the company at Colchester Road, Halstead, Essex.

Change of Address

As from Monday next (October 20), the address of the Worcester branch of **British Insulated Callender's Cables Ltd.** will be 4 Charles Street, Worcester, with the telephone number of Worcester 2070. This branch is under the management of Mr. H. Williams.

de Havilland Comet 4

In view of the recent success of this aircraft, it is interesting to note that **Imperial Chemical Industries Limited,** Metals Division, is supplying titanium for components in the Rolls-Royce "Avon" engines, and for several major structural assemblies. These include top skinning over inner and outer engines, transverse and spar bulkheads, engine seal rings, rear air intake ducts, engine cowl doors and firewalls.

Marston Excelsior Ltd., an I.C.I. subsidiary, is supplying heat exchangers and "Marlite" flexible fuel tanks.

The Stanley Shaper

A new hand tool with applications in a wide range of industries has recently been introduced by **Stanley Works (G.B.) Ltd.** Known as the "Stanley Shaper," it is designed to shape and finish most surfaces from wood, leather and plastics, to asbestos, brick, rubber, and mild steel. The Shaper body is cast in light alloy and the toe grip permits of a variety of hand and finger positions.

Nickel Scrap

With works and offices at 33A Powell Street, Birmingham, 1, telephone number Central 2910, the newly-formed company **Hugo McGhee (Metals) Ltd.,** will trade in scrap metals, concentrating their attention primarily on pure nickel and the nickel-bearing and tungsten alloys. The premises at Powell Street are being taken over from Nicholson and Rhodes Ltd.

Two Films

Two films were given their preview in London last week, sponsored by **The Mond Nickel Company Limited.** A new sound-colour film produced by the company, with the title "Nickel Alloy Permanent Magnets," aims to demonstrate the properties of nickel alloys for permanent magnets, with particular reference to their stability and strength, and surveys some of the latest mechanical and electrical developments which have been facilitated by these materials. The introduction reviews the well-known properties of magnets, and goes on to show the striking increase in the power of magnet materials developed since the turn of the century. The very high stability of nickel-containing magnets is demonstrated by subjecting an Alcomax magnet to extremes of heat, cold and vibration. Sequences include the manufacture of magnets, electrical and mechanical applications in industry, and automatic train control. The film ends with shots of some of the latest uses of nickel alloys in laboratory standards and nuclear resonance magnets. The film is a 750 ft. 16 mm. sound and colour production, and runs for 21 min.

The second film, which revises and brings up-to-date the first film on S.G. Iron, demonstrates how altering the shape of the graphite in cast iron confers upon it unusual properties of strength and ductility. Opening with a brief resumé of the advantages and limitations of ordinary cast iron, the film shows how, with the alteration of graphite shape, S.G. Iron takes on some of the properties of steel while retaining its castability. Reference is made to S.G. Ni-Resist, a high-expansion, non-magnetic alloy, which is even more ductile than other S.G. Irons, and is resistant to heat and corrosion. The two main types of S.G. Iron —Ferritic and Pearlitic—are discussed, with graphs illustrating their stress strain curves. The remarkable ductility of the material in the annealed state is demonstrated, and yet S.G. Iron is seen to be stiffer than ordinary cast iron. Resistance to impact and twisting, machinability, and the versatility of the material in up-to-date applications are illustrated.

The film is a 1,000 ft. 16 mm. sound and colour production, and runs for 28 min. Both films are available on free loan on application to the company.

Trade with Eire

It was recently announced by the Irish Republic Revenue Commissioners that the Eire Government have made an Order, entitled the Imposition of Duties (No. 43) (Metal Fabric and Expanded Metal) Order, 1958. The effect of the Order, which came into operation on September 23 last, is to impose a minimum rate of customs duty on metal fabric and expanded metal (Tariff Ref. No. 151). The amended duty is as follows:

Metal fabric and expanded metal which is, in the opinion of the Revenue Commissioners, designed, constructed and suitable for reinforcing—full rate of duty, 30 per cent *ad valorem* or £60 per ton, and Preferential rate, 20 per cent *ad valorem* or £40 per ton, whichever is, in each particular case, the greater.

Postgraduate Education

A department of aircraft materials has now been established at **The College of Aeronautics,** Cranfield, so that in the future students may elect to take this subject as their main specialization in the postgraduate College Diploma course. This new specialization will embrace engineering techniques in application of materials as well as the basic relevant sciences, particularly physical metallurgy and solid state physics.

It will cover both metals and non-metallic materials, and will deal especially with those branches which are of particular aeronautical concern, such as high-temperature behaviour, dynamic stressing and fabrication. Research forms an essential part of the activity of the department, and several investigations are now in progress, mainly in the fields of creep and fatigue. Students for the new specialization will co-operate in such researches as part of their thesis work.

It is, therefore, intended to set up a short course on materials, of about two months' duration, which will be open to industry generally. The aim of such a course is to present to those concerned with engineering applications of materials a working knowledge of modern developments in materials theory and technology. Those interested in an advanced course of this kind are invited to write to Prof. A. J. Kennedy, B.Sc., Ph.D., A.M.I.E.E., F.Inst.P., at The College of Aeronautics, Cranfield, Bletchley, Bucks., so that some assessment of the potential demand may be made.

Soviet Aluminium

The Board of Trade have been informed by the Soviet authorities that Raznoimport—the foreign trade organization which alone is empowered to sell Soviet aluminium—will not export more than 15,000 tons of unwrought aluminium to the United Kingdom in the next 12 months.

At the same time, the Board of Trade announce that they have decided to take no further action on the application by the Aluminum Co. of Canada Ltd. for an anti-dumping duty under the Customs Duties (Dumping and Subsidies) Act, 1957.

1959 Essay Award

It has been decided by the Education Panel of the Corrosion Group of the **Society of Chemical Industry** to again award a prize for an essay on corrosion science by young authors. This competition was established in 1955 for the purpose of encouraging those who are still in the early stages of their career to take an interest in corrosion science and to express their ideas in writing.

The closing date for receipt of entries is March 31 next year, and essays are invited from persons aged not more than 27 years on the closing date. A length of about 4,000 words is suggested, but reasonable latitude is allowable. Full details and conditions are available from the Corrosion Group Essay Competition, c/o Society of Chemical Industry, 14 Belgrave Square, London, S.W.1.

Silicones in Shell Moulding Industry

A new four-page data sheet on the use of Union Carbide silicones in the shell moulding industry has recently been made available. It describes the properties, advantages, and effective working concentrations of three silicone parting agents. This sheet is published by the Silicones Department, Union Carbide International Company, 30 East 42nd Street, New York, 17, U.S.A.

Enquiry from India

A firm of non-ferrous founders in India is anxious to take up the manufacture of water and steam valve fittings in collaboration with an established British firm. Present import restrictions and the likelihood of further restrictions in the near future make this an opportune time for a British firm to keep their footing in this field. We shall be pleased to furnish the name of the enquiring firm to any interested parties.

An Open Day

On Friday of last week, the **College of Aeronautics** at Cranfield held its "Open" day, and many visitors took the opportunity of going round the college buildings and its various departments. The purpose of the college is to provide engineering and scientific training in aeronautics, at postgraduate level, to enable students to develop a capacity to fill, in due time, senior and responsible positions in the aircraft industry, civil aviation, the Services, education and research.

A considerable amount of research, both departmental and individual, under contract to industry and the Ministry of

Supply, and privately in the fields of particular staff specialization, is carried out, and annually a number of Papers and reports are issued from the College Library.

At the present time, applications for entry to the college total about 200 a year, and a board of entry awards places to about 100 by competition. The accepted students for this present (October) term total 105. The principal of the college is **Prof. A. J. Murphy,** M.Sc., F.I.M., F.R.Ae.S.

Gauge and Tool Makers

This year's annual general meeting of the **Gauge and Tool Makers' Association** is to be held at the Savoy Hotel, London, in the afternoon of Thursday, November 27 next. It will be preceded by an informal luncheon, for members only, at 12.15 for 1 p.m.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week totalled 17,666 tons, comprising London 6,148, Liverpool 10,008, and Hull 1,510 tons. Copper stocks totalled 9,600 tons, and comprised London 5,449, Liverpool 3,626, Birmingham 75, Manchester 300, and Swansea 150 tons.

Scrapped Gun for Museum

Recent business handled by **Arthur E. Milner (Metals) Ltd.,** of Curdworth, Birmingham, has included the purchase of a number of scrap Oerlikon guns. In the course of the negotiations it was suggested that one of these guns, which, though unusable, was otherwise undamaged, should be presented by the company to the Museum of Science and Industry in Birmingham. Accordingly, arrangements were made with the Keeper of the Museum, and on Tuesday this week the gun was handed to the museum authorities. It will shortly be exhibited in the Arms Gallery of the museum.

Management Conference

At the forthcoming National Conference of the **British Institute of Management,** to be held in Brighton from November 26 to 28 next, the theme of the conference will be "The Challenge of Change." The views of top management and specialist management of the large and small organization will be given by the speakers and discussed by some one thousand delegates.

Tariff Commission Enquiries

The Board of Trade has been notified by the U.K. Trade Commissioner in Bombay that the Indian Tariff Commission has announced provisional dates for the following enquiry:—Zinc and lead ingots, sheet and strip—end of November or early December next.

Argonarc Finish

Under the present modernization programme, 2,000 brake horsepower diesel/hydraulic locomotives are being made for British Railways, and the first of these is already in service between Paddington and Bristol. **Lightalloys Limited** are making the cab, which is composed of some 30 separate Alpex castings, which are bolted together. The outside edge of each joint is given a vee preparation, and a ½ in. deep sealing run is put in, using an Argonarc Mark III welding torch supplied by **British Oxygen Gases Ltd.** The torch has a water-cooled shield and the current is 187 amps, which is obtained from a C.P.U. 300/Q power unit. The filler rod used is ⅛ in. Silotectic.

Bronze and Brass Founders

On Monday, October 27, at the Victoria Hotel, Wolverhampton, members in the Midland area of the **Association of Bronze and Brass Founders** will hold a meeting, commencing at 11.30 a.m. At this meeting, matters of current interest will be discussed and, following an interval for luncheon, an open meeting will be held at which the association's new publication, "Costing a Casting," will be explained and discussed.

A Grand Prix Winner

An international jury chosen by the Commissioner-General of the Belgian Government has just awarded the Grand Prix for the best precision mechanics exhibit at the Universal and International Exhibition in Brussels to **British Timken Limited.** The exhibit consisted of a series of light oak showcases, into each of which are built colour transparencies showing various applications of Timken bearings, together with internal and external views of the factory at Duston, Northampton. Bearings on the stand ranged from a slowly revolving giant, weighing 3½ tons, for a rolling mill, down to the smallest bearing, weighing 0·001 oz., manufactured by Fischer Bearings Co. Ltd., a subsidiary of British Timken.

Chilean Copper for Russia

Negotiations for the sale to the Soviet Union of 32,000 metric tons of semi-manufactured Chilean copper have been completed in Western Germany, according to information received by the Chilean Ministry of Mines. The Chilean firms involved in the sale were Cobre Cerillos and Madeco. The first consignment would consist of 22,000 tons of copper sheet and 5·8 millimetre wire, and the balance would be made up of wire of the same type.

Selling to Ghana

One of the Chamberlain Group of companies, **Sanders and Forster Limited,** has established an overseas office in Accra, Ghana, to promote the sales of its range of standard steel-framed buildings, etc. This office is under the management of Mr. Mark Owusu, a Ghanian, who came to the United Kingdom in 1952 to study civil engineering. He obtained his diploma in building engineering with a distinction.

U.S. Quotas Criticized

Recent reports from Washington state that the American Federation of Labour Congress of Industrial Organizations has criticized President Eisenhower's recent action in imposing quotas on importation of lead and zinc into the United States. Mr. George Meany, President of the A.F.L.-C.I.O., said in a statement: "Such action is especially ill-timed because it has resulted in sizeable unemployment and severe hardship to workers in Latin America at the very time when agreement seems to have been reached throughout the Western Hemisphere on the need for an all-out programme to stimulate economic development in Latin America."

The A.F.L.-C.I.O., he said, had favoured an alternative solution to the problem of lead-zinc imports, involving production payments to domestic mines. This would not have resulted in the sharp cut-off of lead and zinc imports which had taken place. Mr. Meany urged that the next Congress take action to "meet the critical lead-zinc situation with legislation which will provide maximum justice for both the American industry and our sister nations in Latin America. In the meantime, we urge the President to review the situation and remove the quotas at the earliest possible date."

U.S. Imports Enquiry

It is understood that the Office of Civil and Defense Mobilization has ordered an enquiry to determine whether imports of cobalt and tungsten ores threaten to impair the U.S. national security by injuring domestic producers. The investigation will be carried out under the Trade Agreements Extension Act, which provides for import restrictions in cases found to affect national security. Petitions requesting the enquiries were lodged by two U.S. producers.

Aluminium Foil Uses

Two new uses for aluminium foil have recently been announced by the **British Aluminium Coil Rollers' Association.** The first is associated with a firm of carton manufacturers, who have found a new use for seal pressing equipment by adapting it to produce decorated foil-to-board blanks much cheaper than hitherto. The press is fed from a reel of material which it cuts, creases, embosses and prints in a single operation. Usually this is a process demanding a series of runs of different machines, and by using this simplified process the company states that aluminium foil containers can be offered printed in up to two colours at a price roughly equal to that of ordinary three-colour cartons. There is, however, one limitation. Embossed blanks measuring 12 in. by 10 in. are the largest that can be made on the machine, and the maximum dimensions are less where a second colour is used.

The second use is that adopted by Booth's Distilleries Ltd., who are replacing board price tags with embossed one-colour crowners punched from a laminate of aluminium foil. These new crowners are produced in a range of four sizes, for full, half, quarter, and miniature bottles, by a Burton-on-Trent company.

Forthcoming Meetings

October 21—Institute of British Foundrymen. Slough Section. Joint Meeting with the London Branch. Lecture Theatre, High Duty Alloys Limited, Slough. "Modern Developments in Aluminium-base Casting Alloys." H. J. Proffitt. 7.30 p.m.

October 21—Institute of Metal Finishing. South-West Branch. Spread Eagle Hotel, Gloucester. Open Forum. J. B. Lane, chairman. 7 p.m.

October 22—Institution of Production Engineers. Norwich Section. The Section Room, Assembly House, Norwich. "Die-Casting. How Would You Make It?" A. R. L. Chivers. 7.30 p.m.

Metal Market News

IT is not long since tin occupied the centre of the stage in non-ferrous metals, but last week that position was taken over by copper, which certainly behaved in an extraordinary fashion. For some days past fears had been entertained about the growing scarcity of supplies, due to the continuation of the Rhodesian strike, and a small backwardation had developed, but this situation grew rapidly worse as the week progressed, and on Friday last at midday the difference between cash and three months was no less than £17. Custom smelters in the States advanced their quotation to 27½ cents on October 8, and Phelps Dodge followed this late on Friday, the news being known here on Saturday morning. Doubtless before these notes appear the other producers will have followed suit. In London, however, on Friday the settlement price was £241, which is equal to 30 cents, and there is no knowing how much higher it will go. Maybe it will prove to be a profitable transaction for American copper to be shipped to this side, for even the three months' quotation at £224 is the equivalent of 28 cents. On balance, cash at £239 10s. 0d., which was the afternoon price, showed a gain of nearly £23, while three months, at £226, was up by £9 15s. 0d. The turnover, including business done on the Kerb, could not have been less than 14,000 tons. Good buying was reported from the Continent, and it is thought that consumers in the U.K. bought a fair tonnage.

L.M.E. stocks showed a further drop of 632 tons to 9,899 tons, and in view of the hectic bidding for the cash position it must be presumed that further substantial falls in this tonnage will be seen in the near future. As at Monday last week, the stocks were less than half what they were in March and, as already mentioned, it looks as though the drain must continue. In due course, copper will be attracted to the London market, but some time may elapse before that takes place. It is, of course, most unfortunate that the copper market has rocketed up in this fashion, for it emphasizes once again the unpredictability of values and makes nonsense of all talk about stability in the price of the metal. That copper should *suddenly* be worth £240 per ton seems all wrong; maybe in due course the quotation might have approached that figure, but there is certainly at the moment no increase in consumption either here or in the States which can possibly be deemed to justify such an advance. Short of absolute necessity, it must be supposed that users will boycott the metal until the market comes to its senses. The return of an onerous backwardation makes it impossible to hedge satisfactorily, and it may be months before matters come right again. Those who are antagonistic to the principle of a free market are likely to make full use of last week's events to press their objections.

The firm tendency which had appeared in tin was not maintained last week and much ground was lost, for the cash price fell by £13 to £732 and three months lost £10 to £728. Business was only moderate. Stocks of tin in L.M.E. warehouses showed little change at 17,514 tons. Both zinc and lead advanced by 50 points in the States to 11 cents and 12½ cents respectively, but in Whittington Avenue neither metal put up much of a show. On balance, October lead was £2 10s. 0d. lower at £71 5s. 0d., while January was down 12s. 6d. at £73. Prompt zinc gained 2s. 6d. to £67 15s. 0d., while January closed 5s. down at £67. Business was not very brisk in either metal.

Birmingham

More people were unemployed last month in the Midland Region than at any time since 1947. Total unemployment, including short-time workers, rose from 35,566 in August to 40,307 in September. But, despite this rise, the region fared better than the country as a whole, with an unemployment percentage of 1·9 compared with 2·2 for the whole of Britain. In Birmingham, the total was 11,291, including 761 short-time workers. There has been no marked change in the position recently. Another indication of slackness is that applications to the Board of Trade to build new factories or extensions are fewer than they were a year ago. It is believed that with easier hire purchase arrangements for household goods there may be an early revival of buying. Machine tool makers say there is a slight improvement in new business.

The iron and steel industry is operating below capacity, and there is no immediate prospect of any improvement. Early delivery can be given of many steel products and there are ample supplies of raw material. Constructional engineers are finding new contracts more difficult to obtain, though the industry is still absorbing a substantial tonnage of heavy joists and sections. The steel re-rolling mills are operating on a short-time basis owing to lack of business in small bars, sections and strip. Even with reduced output the supplies of both foundry and basic pig iron are sufficient to meet all needs.

Opening a safety week exhibition on Monday last at the factory of Joseph Lucas Limited, in Sparkhill, Mr. W. Gissane, director of Birmingham Accident Hospital, stressed the fact that the majority of industrial accidents were due to carelessness. There had, however, been a considerable improvement in recent years, most mishaps occurring now during the handling of goods.

It is understood that the offer by Yorkshire Imperial Metals to buy the Ordinary shares of Hudson and Wright at 6s. 9d. per share, has been accepted by the holders of more than 93 per cent of the capital, and has become unconditional.

New York

A rise of one cent per lb. in the producer price of copper to 27½ cents, with effect from October 13, was announced during the week-end by Phelps Dodge Corporation. Kennecott Corporation soon followed suit. Up to the time of writing, Anaconda, the remaining major producer, had taken no action, but trade sources expected the company to follow the rise in time for October 13 shipments. The advance was attributed to active copper demand, to pressure by fabricators for a higher electrolytic price so they can raise their price for copper products, and to an increase of three-quarters of a cent per lb. to-day by the International Nickel Company.

Custom smelter copper showed a firm undertone at 27½ cents. Lead and zinc were quieter, with moderate sales reported. Some sources ascribed the quietness to the usual slackening of business at the close of the week. Tin was quiet and easier, reflecting the decline abroad.

In the silver market, continuation of the heavy domestic turnover caused another half-cent price boost to 90⅛ cents a fine ounce.

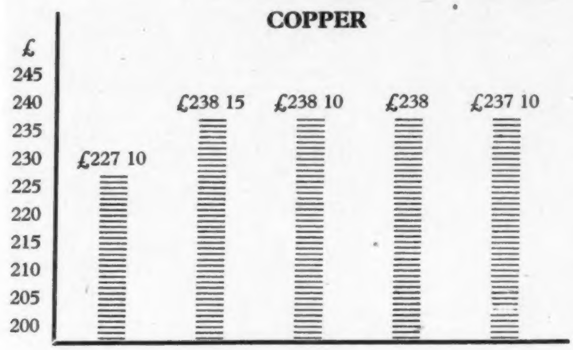
Reynolds Metals Company has disclosed plans to increase aluminium production at its nearby San Patricio plant by two million lb. a month, starting within the next 30 days. The increase reflects a recent improvement in market conditions. It will result in the re-hiring of 100 of the 300 employees laid off last April. Earlier last week, Reynolds and the Aluminum Company of America announced similar production increases in three other aluminium facilities. The increase at the San Patricio plant will bring production there to 14 million lb. a month, about 90 per cent of capacity, the company reported.

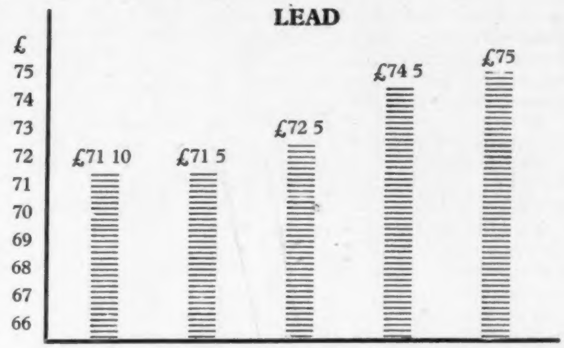
Bombay

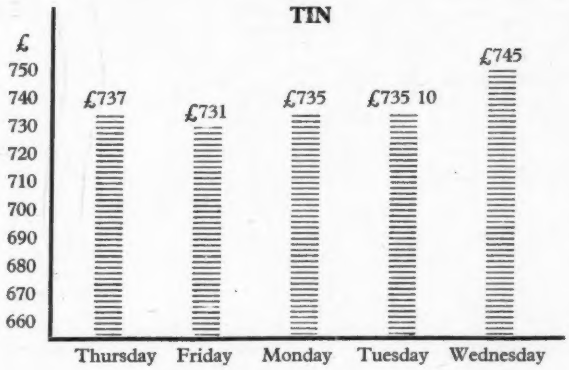
The Government of India has decided that the export of semi-manufactures of copper, such as copper sheets, circles, strips and plates, will continue to be allowed in the same way as the previous licensing period until further orders, the Joint-Chief Controller of Exports has stated. Exports of these items were licensed freely on shipping bill during the previous licensing period.

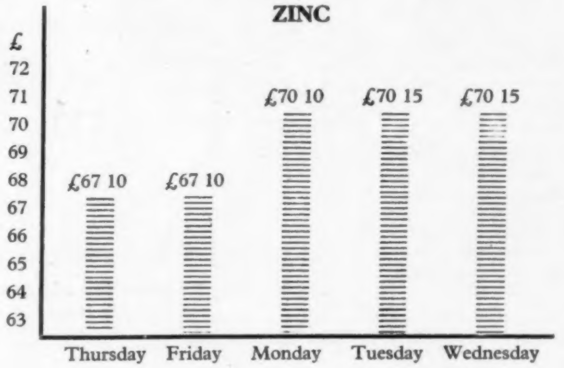
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 9 October 1958 to Wednesday 15 October 1958









OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton		Canada c/lb ≏ £/ton		France fr/kg ≏ £/ton		Italy lire/kg ≏ £/ton		Switzerland fr/kg ≏ £/ton		United States c/lb ≏ £/ton	
Aluminium			22.50	185 17 6	210	182 15	375	217 10			26.80	214 10
Antimony 99.0					195	169 12 6	420	243 12 6			29.00	232 0
Cadmium					1,500	1,305 0					145.00	1,160 0
Copper												
Crude												
Wire bars 99.9							440	255 5				
Electrolytic	31.75	232 0	26.50	218 17 6	271	235 15			2.67	223 5	27.50	220 0
Lead			10.75	88 15	113	98 7 6	179	103 17 6	.89	76 10	13.00	104 0
Magnesium												
Nickel			70.00	578 5	1,205	1,048 7 6	1,300	754 0	7.56	632 2 6	74.00	592 0
Tin	102	745 12 6			895	778 12 6	1,420	823 12 6	8.60	719 2 6	95.87	767 0
Zinc												
Prime western			10.25	84 12 6							11.00	88 0
High grade 99.95			10.85	89 10 0								
High grade 99.99			11.25	92 5								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	165	95 15	.88	73 10	12.25	98 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 15/10/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	,,	197	0	0
Antimony Metal 99%	,,	190	0	0
Antimony Oxide	,,	180	0	0
Antimony Sulphide Lump	,,	190	0	0
Antimony Sulphide Black Powder	,,	205	0	0
Arsenic	,,	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	,,		9	6
Calcium	,,	2	0	0
Cerium 99%	,,	16	0	0
Chromium	,,		6	11
Cobalt	,,		16	0
Columbite	per unit		—	
Copper H.C. Electro	ton	237	10	0
Fire Refined 99·70%	,,	236	0	0
Fire Refined 99·50%	,,	235	0	0
Copper Sulphate	,,	72	10	0
Germanium	grm.		—	
Gold	oz.	12	10	2¼
Indium	,,		10	0
Iridium	,,	20	0	0
Lanthanum	grm.		15	0
Lead English	ton	75	0	0
Magnesium Ingots	lb.		2	5½
Notched Bar	,,		2	10½
Powder Grade 4	,,		6	3
Alloy Ingot, A8 or AZ91	,,		2	8
Manganese Metal	ton	290	0	0
Mercury	flask	78	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	,,		5	6
Osmium	oz.		nom.	
Osmiridium	,,		nom.	
Palladium	,,	5	15	0
Platinum	,,	21	5	0
Rhodium	,,	40	0	0
Ruthenium	,,	15	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	6¼
Tellurium	lb.		15	0
Tin	ton	745	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	,,		—	
Virgin Min 98%	,,	71	10	0
Dust 95/97%	,,	104	0	0
Dust 98/99%	,,	110	0	0
Granulated 99+%	,,	96	10	0
Granulated 99·99+%	,,	110	2	6

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	,,	202	0	0
B.S. 1490 L.M.7	,,	216	0	0
B.S. 1490 L.M.8	,,	203	0	0
B.S. 1490 L.M.9	,,	203	0	0
B.S. 1490 L.M.10	,,	221	0	0
B.S. 1490 L.M.11	,,	215	0	0
B.S. 1490 L.M.12	,,	223	0	0
B.S. 1490 L.M.13	,,	216	0	0
B.S. 1490 L.M.14	,,	224	0	0
B.S. 1490 L.M.15	,,	210	0	0
B.S. 1490 L.M.16	,,	206	0	0
B.S. 1490 L.M.18	,,	203	0	0
B.S. 1490 L.M.22	,,	210	0	0

		£	s.	d.
†Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	144	0	0
B.S. 1490 L.M.2	,,	152	0	0
B.S. 1490 L.M.4	,,	169	0	0
B.S. 1490 L.M.6	,,	187	0	0

†Average selling prices for mid September

		£	s.	d.
***Aluminium Bronze**				
BSS 1400 AB.1	ton	234	0	0
BSS 1400 AB.2	,,		—	
***Brass**				
BSS 1400-B3 65/35	,,	152	0	0
BSS 249	,,		—	
BSS 1400-B6 85/15	,,	187	0	0
***Gunmetal**				
R.C.H. 3/4% ton	,,		—	
(85/5/5/5)	,,	191	0	0
(86/7/5/2)	,,	201	0	0
(88/10/2/1)	,,	249	0	0
(88/10/2/½)	,,	262	0	0
Manganese Bronze				
BSS 1400 HTB1	,,		—	
BSS 1400 HTB2	,,		—	
BSS 1400 HTB3	,,	205	0	0
Nickel Silver				
Casting Quality 12%	,,		nom.	
,, ,, 16%	,,		nom.	
,, ,, 18%	,,		nom.	
***Phosphor Bronze**				
B.S. 1400 P.B.1 (A.I.D. released)	,,	270	0	0
B.S. 1400 L.P.B.1	,,	215	0	0
Phosphor Copper				
10%	,,	239	10	0
15%	,,	244	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	,,		—	
Solder, soft, BSS 219				
Grade C Tinmans	,,	351	15	0
Grade D Plumbers	,,	285	10	0
Grade M	,,	385	0	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 ,,	,,		—	
Zinc Alloys				
Mazak III	ton	103	7	6
Mazak V	,,	107	7	6
Kayem	,,	113	7	6
Kayem II	,,	119	7	6
Sodium-Zinc	lb.		2	6

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8
Sheet 18 S.W.G.	,,		2	10
Sheet 24 S.W.G.	,,		3	1
Strip 10 S.W.G.	,,		2	8
Strip 18 S.W.G.	,,		2	9
Strip 24 S.W.G.	,,		2	10½
Circles 22 S.W.G.	,,		3	2
Circles 18 S.W.G.	,,		3	1
Circles 12 S.W.G.	,,		3	0
Plate as rolled	,,		2	7½
Sections	,,		3	1½
Wire 10 S.W.G.	,,		2	11
Tubes 1 in. o.d. 16 S.W.G.	,,		4	0

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	,,		3	0½
Sheet 18 S.W.G.	,,		3	3
Sheet 24 S.W.G.	,,		3	10½
Strip 10 S.W.G.	,,		3	0½
Strip 18 S.W.G.	,,		3	2
Strip 24 S.W.G.	,,		3	10
BS1477. HP30M.				
Plate as rolled	,,		2	10½
BS1470. HC15WP.				
Sheet 10 S.W.G.	,,		3	6½
Sheet 18 S.W.G.	,,		4	0½
Sheet 24 S.W.G.	,,		4	10½
Strip 10 S.W.G.	,,		3	9½
Strip 18 S.W.G.	,,		4	0½
Strip 24 S.W.G.	,,		4	8
BS1477. HPC15WP.				
Plate heat treated	,,		3	5½
BS1475. HG10W.				
Wire 10 S.W.G.	,,		3	9½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	,,		4	11
BS1476. HE10WP.				
Sections	,,		3	1
Beryllium Copper				
Strip	,,	1	4	11
Rod	,,	1	1	6
Wire	,,	1	4	9
Brass Tubes	,,		1	10½
Brazed Tubes	,,		—	
Drawn Strip Sections	,,		—	
Sheet	ton		—	
Strip	,,	254	0	0
Extruded Bar	lb.		2	0¼
Extruded Bar (Pure Metal Basis)	,,		—	
Condenser Plate (Yellow Metal)	ton	189	0	0
Condenser Plate (Naval Brass)	,,	200	0	0
Wire	lb.		2	8
Copper Tubes	lb.		2	4
Sheet	ton	271	0	0
Strip	,,	271	0	0
Plain Plates	,,		—	
Locomotive Rods	,,		—	
H.C. Wire	,,	291	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	7⅜
Lead Pipes (London)	ton	113	15	0
Sheets (London)	,,	111	10	0
Tellurium Lead	,,	£6 extra		
Nickel Silver				
Sheet and Strip 7%	lb.		3	6
Wire 10%	,,		4	0½
Phosphor Bronze				
Wire	,,		4	1⅜

Titanium (1,000 lb. lots)			
Billet over 4″ dia.-18″ dia.	lb.	63/-	64/-
Rod 4″ dia.-·250″ dia.	,,	75/-	112/-
Wire under ·250″ dia.-·036″ dia.	,,	146/-	222/-
Sheet 8′ × 2′ × ·250″-·010″ thick	,,	88/-	157/-
Strip ·048″-·003″ thick	,,	100/-	350/-
Tube (representative gauge)	,,		300/-
Extrusions	,,		120/-

		£	s.	d.
Zinc Sheets, English destinations	ton	104	0	0
Strip	,,		nom.	

Financial News

Metal Statistics

Detailed figures of the consumption and output of non-ferrous metals for the month of Aug., 1958, have been issued by the British Bureau of Non-Ferrous Metal Statistics, as follow in long tons:—

COPPER	Gross Weight	Copper Content
Wire	20,297	20,063
Rods, bars and sections	8,828	5,892
Sheet, strips and plate	8,608	6,826
Tubes	5,073	4,681
Castings and miscellaneous	5,571	—
Sulphate	528	—
	48,905	42,181

Of which:

Consumption of Virgin Copper	33,073
Consumption of Copper and Alloy Scrap (Copper Content)	9,108

ZINC	
Galvanizing	6,033
Brass	5,839
Rolled Zinc	1,800
Zinc Oxide	1,449
Zinc Die-casting alloy	2,414
Zinc Dust	687
Miscellaneous Uses	854
Total, All Trades	19,076

Of which:

High purity 99·99 per cent	2,629
Electrolytic and high grade 99·95 per cent	3,599
Prime Western, G.O.B. and debased	7,675
Remelted	387
Scrap Brass and other Cu alloys	2,651
Scrap Zinc, alloys and residues	2,000

ANTIMONY	
Batteries	86
Other Antimonial Lead	43
Bearings	26
Oxides—for White Pigments	67
Oxides—other	64
Miscellaneous Uses	14
Sulphides	3
Total Consumption	303

Antimony in Scrap	
For Antimonial Lead	250
For Other Uses	12
Total Consumption	262

LEAD	
Cables	6,049
Batteries	2,031
Battery Oxides	1,693
Tetra Ethyl Lead	1,650
Other Oxides and Compounds	1,150
White Lead	559
Shot	275
Sheet and Pipe	4,512
Foil and Collapsible Tubes	205
Other Rolled and Extruded	411
Solder	868
Alloys	1,391
Miscellaneous Uses	932
Total	21,726

CADMIUM	
Plating Anodes	41·60
Plating Salts	3·15
Alloys: Cadmium Copper	2·45
Alloys: Other	1·35
Batteries: Alkaline	4·15
Batteries: Dry	0·20
Solder	5·50
Colours	7·35
Miscellaneous Uses	1·15
Total Consumption	66·90

TIN	
Tinplate	618
Tinning:	
Copper Wire	36
Steel Wire	6
All other	55
Solder	174
Alloys	404
Foil and Collapsible Tubes, etc.	40
Tin Compounds and Salts	69
Miscellaneous Uses	10
Total Consumption	1,412

Metal Traders Ltd.

For the year ended March 31, 1958, group profits are shown at £280,830 (£446,903), taxation takes £144,530, leaving a net profit of £136,300 (£202,283). Recommended dividend 37½ per cent and bonus of 12½ per cent.

R. Johnson, Clapham and Morris

Final dividend 15 per cent (same) making 20 per cent year ended June 30, 1958 (same). Consolidated net profit £76,280 (£70,143), before tax of £36,277 (£34,192) and bonus to employees £8,000 (£7,500). To general reserve £20,000 (£15,000). Forward £9,067 (£11,586). Group fixed assets £258,826 (£226,632), current £887,483 (£854,316) and liabilities £733,210 (£687,130), of which bank overdraft £209,462 (£178,310). Future tax £27,500 (£25,700). Commitments £4,000.

Thos. W. Ward Ltd.

Group profits for the year ended June 30 last declined from £2,701,625 to £2,599,158, from which tax of £1,425,448 (£1,452,623) has been deducted, leaving a net profit of £1,173,710, against £1,249,002. A final dividend has been declared of 10 per cent, plus a bonus of 5 per cent, making a 20 per cent total for the year. In addition to the group profit, it is stated that a sum of £249,893 has been placed to capital reserve, representing a dividend received from a subsidiary out of realized capital profits together with the profit from realizations of shareholdings in a subsidiary during the year.

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 14/10/58.

	£
Aluminium	
New Cuttings	134
Old Rolled	110
Segregated Turnings	90
Brass	
Cuttings	138
Rod Ends	133
Heavy Yellow	116
Light	111
Rolled	127
Collected Scrap	114
Turnings	128
Copper	
Wire	196
Firebox, cut up	190
Heavy	183
Light	177
Cuttings	194
Turnings	175
Braziery	153

	£
Gunmetal	
Gear Wheels	180
Admiralty	180
Commercial	154
Turnings	149
Lead	
Scrap	61
Nickel	
Cuttings	—
Anodes	500
Phosphor Bronze	
Scrap	154
Turnings	149
Zinc	
Remelted	55
Cuttings	42
Old Zinc	28

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£195.17.6)	225
Heavy copper	(£191.10.0)	220
Light copper	(£161.0.0)	185
Heavy brass	(£119.2.6)	137
Light brass	(£91.7.6)	105
Soft lead scrap	(£61.0.0)	70
Zinc scrap	(£34.17.6)	40
Used aluminium unsorted	(£87.0.0)	100
France (francs per kilo):		
Copper	(£208.17.6)	240
Heavy copper	(£208.17.6)	240
Light brass	(£143.10.0)	165
Zinc castings	(£65.5.0)	75
Lead	(£82.12.6)	95
Tin	—	
Aluminium	(£117.10.0)	135

Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£191.10.0)	330
Aluminium copper alloy	(£119.0.0)	205
Lead, soft, first quality	(£84.12.6)	146
Lead, battery plates	(£49.17.6)	86
Copper, first grade	(£200.2.6)	345
Copper, second grade	(£186.12.6)	320
Bronze, first quality machinery	(£197.5.0)	340
Bronze, commercial gunmetal	(£168.5.0)	290
Brass, heavy	(£130.7.6)	235
Brass, light	(£124.15.0)	215
Brass, bar turnings	(£133.10.0)	230
New zinc sheet clippings	(£55.2.6)	95
Old zinc	(£40.12.6)	70

THE STOCK EXCHANGE

Market Very Active And Many Equities At Highest This Year

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 14 OCTOBER	+RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	22/6	+9d.	9	10	8 0 0	22/6	17/6	28/3	18/–
400,000	2/–	Anti-Attrition Metal	1/6		4	8½	5 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	55/3	+2/6	15	15	5 8 6	55/3	46/6	72/3	47/9
1,590,000	1	Birfield Industries	61/–	+6d.	15	15	4 18 3	61/–	46/3	70/–	48/9
3,196,667	1	Birmid Industries	74/–	+2/–	17½	17½	4 14 6	76/3	55/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	32/–	+3d.	10	8	6 5 0	32/3	23/9	33/–	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/10½		5	5	6 6 0	16/1½	14/7½	16/–	15/–
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/1½		6	6	7 0 3	17/4½	16/6	19/–	16/6
500,000	1	Bolton (Thos.) & Sons	26/3		12½	12½	9 10 6	28/9	24/–	30/3	28/9
300,000	1	Ditto Pref. 5%	15/3	+3d.	5	5	6 11 3	16/–	15/–	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/–		7	7	7 0 0	19/4½	19/–	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	54/6	+6/6	12	12	4 8 0	54/9	36/6	72/–	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	20/–		6	6	6 0 0	20/–	18/4½	21/6	18/–
15,000,000	Stk. (£1)	British Insulated Callender's Cables	46/3	+6d.	12½	12½	5 8 0	46/9	38/9	55/–	40/–
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	43/6	+3/3	10	10	4 12 0	43/6	29/–	39/–	29/6
600,000	Stk. (5/–)	Canning (W.) & Co.	24/4½	+1/–	25+ *2½C	25	5 2 6	24/4½	19/7½	24/6	19/3
60,484	1/–	Carr (Chas.)	1/10½		25	25	9 6 9X	2/3	1/4½	3/6	2/1½
150,000	2/–	Case (Alfred) & Co. Ltd.	4/9	+3d.	25	25	10 10 6	4/9	4/–	4/6	4/–
555,000	1	Clifford (Chas.) Ltd.	19/9		10	10	10 2 6	20/–	16/–	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/6		6	6	7 14 9	15/10½	15/7½	17/6	16/–
250,000	2/–	Coley Metals	3/3		20	25	12 6 3	4/6	2/6	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	53/6		18¾	22½	7 0 3	53/6	41/–	92/6	49/–
1,136,233	1	Davy & United	74/–	+1/6	20	15	5 8 0	74/–	45/9	60/6	42/6
2,750,000	5/–	Delta Metal	23/9	+3d.	30	*17½	6 6 3	23/9	17/7½	28/6	19/–
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	36/6		12½	15B	6 17 0	36/6	22/9	38/6	25/–
750,000	1	Evered & Co.	27/6	+4½d.	15Z	15	7 5 6	28/3	26/–	52/9	42/–
18,000,000	Stk. (£1)	General Electric Co.	39/6	+1/3	10	12½	5 1 3	39/6	29/6	59/–	38/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	36/3	—6d.	20	17½	5 10 3	37/6	27/3	37/–	26/9
401,240	1	Gibbons (Dudley) Ltd.	63/–	+6d.	15	15	4 15 3	66/3	61/–	71/–	53/–
750,000	5/–	Glacier Metal Co. Ltd.	7/7½	+1½d.	11½	11½	7 10 9	7/7½	5/6	8/1½	5/10½
1,750,000	5/–	Glynwed Tubes	17/4½	—1½d.	20	20	5 15 0	17/6	12/10½	18/–	12/6
5,421,049	10/–	Goodlass Wall & Lead Industries ...	26/3		13‖	18Z	4 19 0	25/9	19/3	37/3	28/9
342,195	1	Greenwood & Batley	51/–	+6d.	20	17½	7 16 9	51/–	45/–	50/–	46/–
396,000	5/–	Harrison (B'ham) Ord.	15/3		*15	*15	4 18 6	15/3	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	19/–		7	7	7 7 3	19/–	18/9	22/3	18/7½
1,075,167	5/–	Heenan Group	9/7½	+9d.	10	20‡	5 4 0	9/7½	6/9	10/4½	6/9
236,953,260	Stk. (£1)	Imperial Chemical Industries ...	34/1½	—1½d.	12Z	10	4 13 9	34/6	27/7½	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	17/1½	+1½d.	5	5	5 16 9	17/1½	16/–	18/6	15/6
14,584,025	**	International Nickel	168½	+10½	$3.75	$3.75	3 19 0	168½	132¾	222	130
430,000	5/–	Jenks (E. P.), Ltd.	8/9	+3d.	27½φ	27½	7 17 3	8/9	6/9	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	15/9	—6d.	5	5	6 7 0	16/9	15/–	17/–	14/6
3,987,435	1	Ditto Ord.	42/9	+9d.	10	10	4 13 6	45/3	36/6	58/9	40/–
600,000	10/–	Keith, Blackman	23/3	+9d.	17½	15	7 10 6	23/3	15/–	21/9	15/–
160,000	4/–	London Aluminium	4/1½		10	10	9 14 0	4/4½	3/–	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	55/6	+9d.	12½	12½	4 10 0	55/6	39/9	54/6	41/–
400,000	1	Ditto Pref.	23/3		7½	7½	6 9 0	23/3	22/3	25/3	21/9
765,012	1	McKechnie Brothers Ord.	40/–		15	15	7 10 0	40/–	32/–	48/9	37/6
1,530,024	1	Ditto A Ord.	42/6		15	15	7 1 3	42/6	30/–	47/6	36/–
1,108,268	5/–	Manganese Bronze & Brass	11/9	—3d.	20	27½‡	8 10 3	12/3	8/9	21/10½	7/6
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–		7½	7½	7 10 0	6/3	5/9	6/6	5/–
13,098,855	Stk. (£1)	Metal Box	62/3	+2/9	11	11	3 10 6	62/3	41/9	59/–	40/3
415,760	Stk. (2/–)	Metal Traders	8/9		50	50	11 8 6	8/9	6/3	8/–	6/3
160,000	1	Mint (The) Birmingham	20/–		10	10	10 0 0	22/9	19/–	25/–	21/6
80,000	5	Ditto Pref. 6%			6	6		83/6	79/6	90/6	83/6
3,705,670	Stk. (£1)	Morgan Crucible A	40/6		10	10	4 18 9	40/6	34/–	54/–	35/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/6		5½	5½	6 5 9	17/6	17/–	19/3	16/–
2,200,000	Stk (£1)	Murex	56/9	+5/9	17½	20	6 3 4	58/9	47/9	79/9	57/–
468,000	5/–	Ratcliffs (Great Bridge)	10/9	+3d.	10	10	4 13 0	10/9	6/10½	8/–	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	25/–	+3d.	20	27½D	8 0 0	27/–	24/6	41/–	24/9
1,365,000	Stk. (5/–)	Serck	16/10½	—10½d.	17½Z	15	3 9 3	16/10½	11/–	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	70/9	+1/–	18	16	5 2 6	70/9	43/9	57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	23/6		6½	6½	5 10 9	24/3	19/6	21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	72/6	+2/6	17½	15	4 16 6	72/6	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	32/9		10	10	6 2 0	34/–	28/9	46/–	29/–
750,000	Stk. (£1)	Ditto Pref. 5%	15/–		5	5	6 13 3	15/6	14/3	18/–	14/–
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	21/9		*5	*5	7 1 3A	23/–	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	85/9	+1/–	20	15	4 13 3	85/9	70/9	83/–	64/–
2,666,034	Stk. (£1)	Westinghouse Brake	42/9	+1/–	10	18P	4 13 6	42/9	32/6	85/–	29/1½
225,000	2/–	Wolverhampton Die-Casting ...	9/9		25	40	5 2 6	9/6	7/1½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	20/10½	+1/1½	27½	27½	6 11 9	20/10½	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	4/10½	+1½d.	20	17½E	10 5 3	4/10½	3/3	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	12/9		6	6	9 8 3	12/9	11/3	12/6	11/3
150,000	1/–	Zinc Alloy Rust Proof	2/10½		27	40D	9 7 9	3/1½	2/7½	5/–	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized issue. • The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/– per share for £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. φ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.